HGM-MZ
Halogen Gas Monitor – Multi Zone

Instruction 3015-5074
Installation / Operation / Maintenance

UL 61010-1
CAN/CSA 22.2 No.61010.1

Rev. 2 –April 2009

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Manufacturer's address:	621 Hunt Valley Circle New Kensington, PA 15068
Product Name:	HGM-MZ (Halogen Gas Monitor) European EMC Directive 2004/108/EC EN55011 – Emissions Product Specific Standard EN61326-1 – Immunity Product Specific Standard EN61010-1 – Safety requirements for Electrical Equipment For Measurement, Control, and Laboratory Use-Part 1: General Requirements

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1 Introduction

About This Manual

Thank you for investing in a Bacharach HGM-MZ Refrigerant Gas Monitor.

To assure operator safety and the proper use of the HGM-MZ please read the contents of this manual, which provides important information on the installation, operation, and maintenance of the monitor.

If you have a working knowledge of refrigerant monitors, you will find this manual useful as a reference tool. If you are new to the use of refrigerant monitors, this document is educational in the principles of refrigerant gas detection and the proper operation of this device by reading this manual thoroughly.

This manual provides important information about the installation, operation, and servicing of the HGM-MZ Refrigerant Monitor and HGM-RD Display Module.

Warning Statements

The use of the word **WARNING** in this manual denotes a potential hazard associated with the use of this equipment. It calls attention to a procedure, practice, or condition, or the like, which if not correctly performed or adhered to, could result in personal injury or death.

Caution Statements

The use of the word **CAUTION** in this manual denotes a potential hazard associated with the use of this equipment. It calls attention to a procedure, practice, condition, or the like, which if not correctly performed or adhered to, could result in damage to the equipment.

Hazard Symbols on Monitor

This symbol indicates the need to consult this operating instruction manual when opening the enclosure.

WARNING: *A potential risk exists if the operating instructions are not followed.*

This symbol indicates the presence of electric shock hazards when the enclosure is opened.

WARNING: *To avoid risk of injury from electric shock, do not open the enclosure without first disconnecting AC power.*

Safety Precautions

AC Power Supply

The HGM-MZ uses a universal power supply that is capable of accepting inputs of 100 to 240 VAC, 50/60 Hz. The monitor's power consumption is 20 Watts. It is highly recommended that the monitor be connected directly to the AC power source, preferably on its own circuit with UPS or surge protection.

- A switch or circuit breaker must be included in the building installation.
- The switch must be in close proximity to the monitor and within easy reach of the operator.
- The switch must be clearly marked as the disconnecting device for the equipment.

Protective Grounding

Under no circumstances should the HGM-MZ be operated without connection to a protective ground. Doing so poses a potential shock hazard and is also a violation of electrical safety standards applicable to this type of equipment.

Explosive Atmosphere

Do not operate this equipment in the presence of flammable liquids, vapors or aerosols. Operation of any electrical instrument in such an environment constitutes a safety hazard.

Proper Exhaust Venting

It is imperative that the exhaust port on this instrument be properly vented as described in this manual. Failure to do so may constitute a safety hazard.

Accessing the Interior of the Monitor

Extreme care should be exercised when accessing the interior of the monitor. Only qualified electrical maintenance personnel should perform connections and adjustments. Always remove AC power before opening the monitor's enclosure.

Misuse & Modifications to the Instrument

The protection provided by the monitor may be impaired if the monitor is used in a manner not specified by Bacharach, Inc. Modifications to this monitor, not expressly approved, will void the warranty.

In Case of Malfunction

Do not continue to use this equipment if there are any symptoms of malfunction or failure. In the case of such occurrence, de-energize the power supply and contact a qualified repair technician or the nearest Bacharach Service Center. Use ONLY the provided knockouts for electrical and communication wiring. Drilling into the box will void the warranty.

Fusing

F1, F2: 1.0 A, 250 VAC, Type "F"

Installation Category

Installation Category II, Pollution Degree II, as defined by UL.

Altitude Limit

6,562 ft (2,000 m)

Cleaning

To clean the outside of the case use a **DRY CLOTH**. To avoid shock hazard and/or equipment damage, DO NOT use soap and water.

Functional Overview

General Description

Refrigerant monitors are specified to support compliance to federal, state and local safety codes governing refrigerant emissions. Avoiding significant refrigerant loss reduces equipment replacement costs, maintains equipment efficiency, promotes safety, and protects the environment.

The Bacharach HGM-MZ provides continuous monitoring of refrigerant gas levels in up to 16 separate test zones. The instrument is easily programmed to monitor a variety of gasses and independent leak (small), spill (medium), and evacuation (large) levels may be designated for each zone. The instrument also retains a log of previous readings that can be easily accessed for analysis.

An audible alarm and front panel indicators are provided to signal alarm and fault conditions, and relay contacts are provided that can be used to trigger external alarm devices in the event of a system fault, or if a leak (small), spill (medium), or evacuation (large) level of gas is detected. The system also may be fitted with and optional two channel 4-20mA current loop board for connection to remote monitoring equipment.

The HGM-MZ requires only minor periodic maintenance such as the occasional replacement of filters. The monitor incorporates active diagnostics that continuously check the system for proper operation. A front panel indicator is provided to alert an operator of system malfunctions, and fault codes are generated that enable the user to identify the cause of the fault.

Communication Options

The HGM-MZ features full two-way communications via an RS-485 interface. MODBUS RTU is the communication protocol standard. The instrument can be connected directly to a Building Management System or it may be operated as a stand-alone system.

An RS-232C port is also provided for connection to a PC. This enables the HGM-MZ to be setup from a personal computer.

Please refer to the **Appendix** for a more complete discussion of communication protocols.

Understanding Monitoring Levels

Effective use of this instrument requires an understanding of what constitutes reasonable alarm set points for the types of gasses monitored. Refrigerant manufacturers define allowable exposure levels and threshold limit values in units of parts per million (ppm). In a good “tight” installation these background levels will be acceptably low and often do not require corrective action. You can reduce nuisance alarms and needless service calls if the alarm levels are set at practical limits. Bacharach has developed recommended monitoring levels based on compliance to ANSI/BSR ASHRAE 15-1994 and ASHRAE Safety Code 34-1992. These reference levels are listed in the Appendix.

Setting the monitor at these recommended alarm levels will satisfy the needs of most users. However, the ppm levels generated by system leaks into the environment are greatly influenced by the volume of air in the sampling area, air circulation, size of the leak, distance to the monitoring point, and a host of other variables. In some cases the set points may need to be adjusted either up or down to achieve effective monitoring.

Response to the Presence of Multiple Refrigerants

The HGM-MZ is a refrigerant level monitor, not a gas analyzer. You must program the monitor to test for a specific refrigerant, and it will only return accurate concentration readings for that particular refrigerant. If a leak occurs of another refrigerant gas type, the monitor may return incorrect readings.

Most applications only require detection of a single refrigerant and the problems that are associated with monitoring multiple gases are rarely an issue. If there is a possibility of multiple refrigerants leaking in the same sampling zone, then you should carefully consider which refrigerant compound you program the unit to monitor.

Suggested Location of Sampling Points

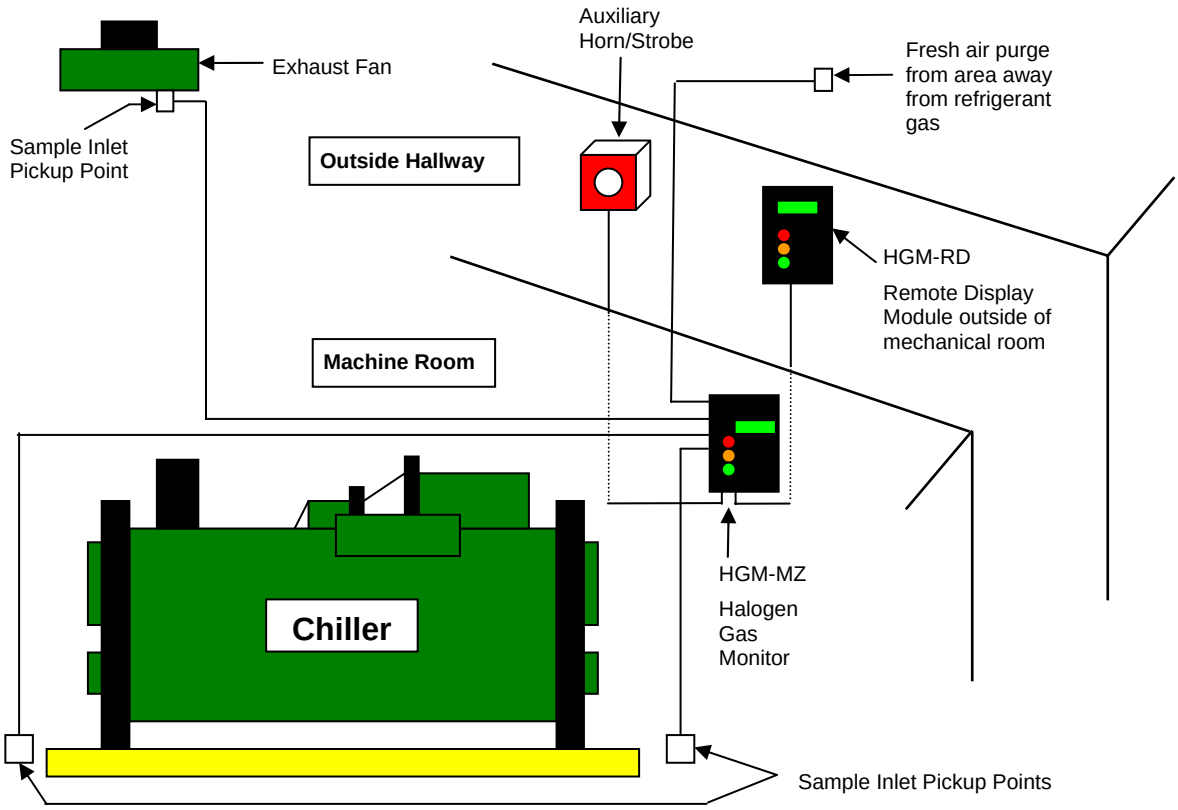
At the point of a refrigerant leak the gas is nearly pure. As the refrigerant is dispersed into the air, the gas molecules diffuse, causing a dilution of the original concentration. The HGM-MZ measures the refrigerant concentration at the sample collection point. Therefore, if the termination of the collection line is not at the exact point of the refrigerant leak, the unit will read a diluted mixture of the refrigerant gas and air.

It should also be noted that refrigerant gas is heavier than air and tends to collect below the point of a leak. Therefore a sample taken near the floor will have a greater concentration of gas than that collected above the source of a leak. Therefore, sampling points should be located as close as possible to the sources of potential leaks. If this is impractical, then the alarm set points should be adjusted for that zone to compensate for the dilution of the refrigerant gas. Sample inlet filters should be mounted 12-18" above the floor. **DO NOT block any of the zones.** Unused zones may be disabled by setting the distance parameter to zero feet in the zone setup screen.

The HGM-MZ should be centrally located in the mechanical room and be readily accessible for easy visual monitoring and servicing. The combined length of sample tubing, plus exhaust tubing, should not exceed 1200ft. for any zone. The fresh air purge line should draw from an area that does not contain any refrigerant gas. The exhaust line should run to an outside location if possible. The combined length of the purge line and the exhaust line cannot exceed **300 feet**.

Ideally, two to three pick up points spaced around each chiller will provide sufficient coverage. It may be necessary to perform a "smoke" test of the mechanical room to determine the best locations. The smoke test would provide the pattern of air currents present in the mechanical room.

HGM-MZ / HGM-RD Refrigerant Gas leak Monitor Mechanical Room Placement



The HGM-RD should be mounted outside of the mechanical room, or just inside the room's doorway if the first option isn't possible. This is the "split architecture design" for safety of the operator. The HGM-RD can be located up to 4500 feet from the HGM-MZ. The HGM-RD is the man machine interface by which you program the HGM-MZ, acknowledge alarms and observe conditions inside of the mechanical room. Note that there are two additional alarm relay contacts in the HGM-RD that can be programmed to alarm with "leak, spill, evacuate, fault or monitor on".

2 Installation

HGM-MZ Front View

*Open cover for mounting instructions (page11)

Standard Accessories for a 4-Point System

- 5 Line-End Filters (P/N 3015-3420)
- Charcoal Filter (P/N 3015-3125)
- T-Bolt Bracket (P/N 3015-2969)
- HGM-MZ Instruction Manual (P/N 3015-5074)

Installation Considerations

⚠ Warnings & Cautions

WARNING: *Explosion hazard! Do not mount the HGM-MZ in an area that may contain flammable liquids, vapors or aerosols. Operation of any electrical equipment in such an environment constitutes a safety hazard.*

WARNING: *Shock hazard! Always disconnect AC power before working inside the monitor.*

CAUTION: *Drilling holes in the HGM-MZ enclosure may damage the unit and will void the warranty. Please use the knockouts provided for electrical connections.*

CAUTION: *The HGM-MZ contains sensitive electronic components that can be easily damaged. Do not touch nor disturb any of these components.*

Inspection

The HGM-MZ has been thoroughly inspected and tested prior to shipment from the factory. Nevertheless, it is recommended that the monitor be re-checked prior to installation. Inspect the outside of the enclosure to make sure there are no obvious signs of shipping damage. Open the enclosure and inspect the interior of the monitor for loose components that may have become dislodged during shipment. If damage is discovered, please contact the nearest Bacharach Service Center for assistance.

Location of the Monitor

The HGM-MZ should be centrally located in the facility and should be easily accessible for visual monitoring and servicing. Intake sample lines can be up to 1,200 feet in length, but it is important to remember that sampling cycle time is proportional to the total number and length of individual sample lines.

Dirt, grease, and oils can adversely affect the operation of the HGM-MZ. The monitor should be installed out of direct sunlight in a clean, dry area that is not subject to temperature or humidity extremes. Installation of the monitor in a mechanical room is acceptable provided reasonable environmental conditions exist. If there is a question, consider installing the unit outside of the mechanical room in a cleaner area of the facility.

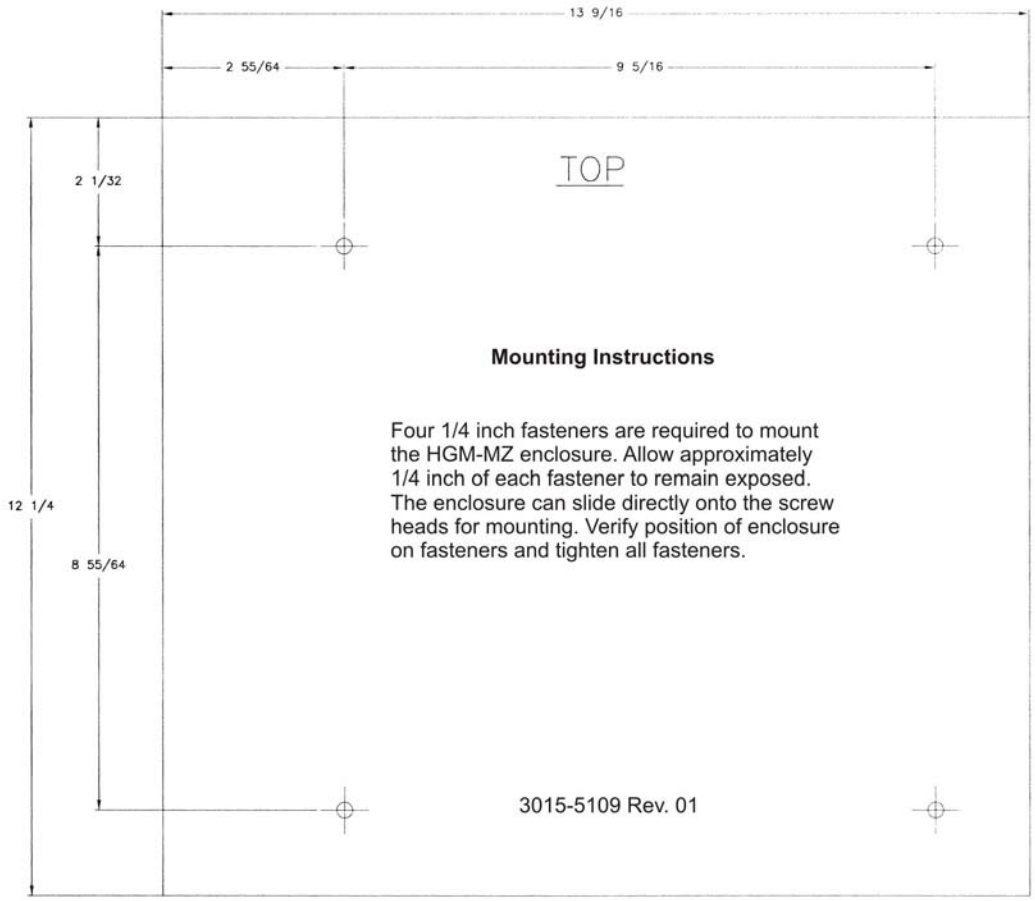
The location should allow the monitor to be easily accessible for visual monitoring and servicing.

Mounting Instructions

The HGM-MZ should be installed plumb and level and securely fastened to a rigid mounting surface.

The enclosure utilizes keyhole mounting brackets designed for 1/4 inch fasteners. Locate the four screws as shown in the diagram below or by using the provided mounting template (P/N 3015-5109). Allow the screw heads to protrude approximately 1/4".

HGM-MZ Mounting Specifications


13 9/16
2 55/64
9 5/16
TOP
2 1/32
Mounting Instructions
Four 1/4 inch fasteners are required to mount the HGM-MZ enclosure. Allow approximately 1/4 inch of each fastener to remain exposed. The enclosure can slide directly onto the screw heads for mounting. Verify position of enclosure on fasteners and tighten all fasteners.
12 1/4
8 55/64
3015-5109 Rev. 01

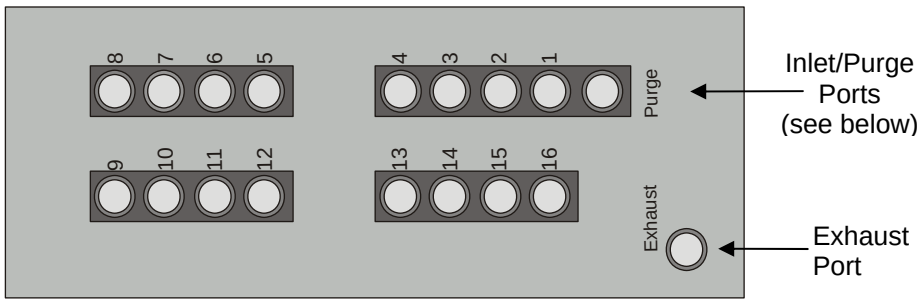
Hold the monitor flat against the mounting surface and allow it to slide down, engaging the screw heads in the keyhole slots of the mounting brackets. Adjust the screws as necessary to hold the monitor securely against the mounting surface.

Connecting Air Lines

Overview

Individual sample lines are run from the HGM-MZ to each area of the facility to be monitored. Additionally, a purge line is installed to provide clean air for resetting the infrared zero baseline. All air line connections, located on the left side of the enclosure, are displayed below.

HGM-MZ Side View



Tubing Considerations

Use ¼" outside diameter (0.040" wall) flex tubing for all air lines (P/N 3015-3235) or equivalent. The tubing should be clean and free of residual moisture or other contaminants. The tubing should be cut cleanly with a sharp knife and care should be taken not to distort the tubing end.

To connect the air lines to the monitor simply push the tubing firmly onto the connector. To remove a line, depress the plastic ring on the connector with one hand while withdrawing the tube with your other hand. All tubing bends should have a radius of no less than 5" to ensure proper airflow. If kinks or obstructions occur in any of the air lines the instrument may not function properly.

Connecting Purge Line

A purge line is required to draw fresh air into the instrument and should not exceed 300 feet in length. It is advisable to terminate the purge line outdoors, provided the input is not exposed to rain, snow, ice, exhaust fumes, or other airborne contaminates. If an outdoor installation is impractical, the line should be run to an area inside the facility that you are certain is not contaminated with ambient refrigerant gas. If this is not possible, an optional charcoal filter assembly (P/N 3015-3125) can be used to filter refrigerant from the purge line, it may be mounted adjacent to the monitor. A line-end filter (P/N 3015-3420) should be attached to the end of the purge line when the charcoal filter is not used.

Connecting Exhaust Line

An exhaust line can be used when it is required to vent gas samples away from the instrument and should not exceed 300 feet in length. The exhaust line should terminate in a location that is completely isolated from the purge line termination point and other areas of the facility that will be monitored. Ideally this line should terminate outdoors in a location that is not exposed to the elements. This line does not require a line-end filter. If the exhaust line terminates outside the building, position the tubing so that no water or moisture can enter it.

Connecting Sample Intake Lines

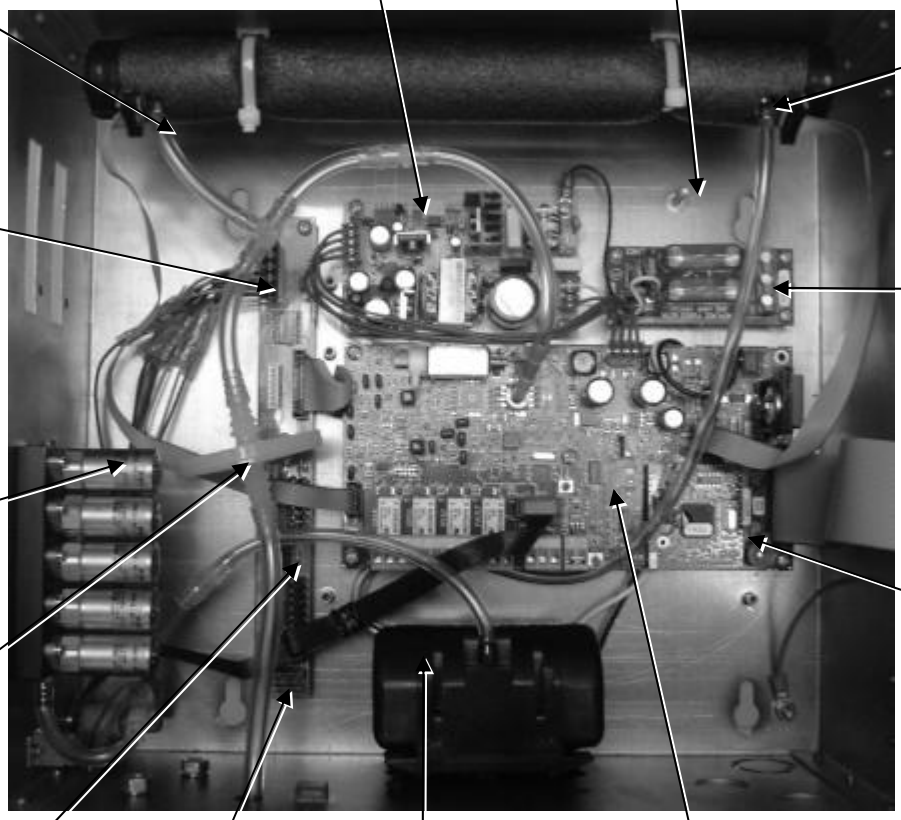
The HGM-MZ is designed to accommodate up to 16 separate sample intake lines. The standard configuration of the unit includes one manifold of 4 intake connectors and 1 purge connector. Additional manifolds can be easily installed to increase monitoring capacity (field installation kit P/N 3015-5171, and 4 zone line end filter kit P/N 3015-3411).

Sample intake lines can be up to 1,200 feet when no exhaust tubing is used. Otherwise, the combined length of the sample line and the exhaust line cannot exceed 1,200ft.. All line terminations should be positioned to reduce the possibility of mists, aerosols, oil, water, dust, or other contaminates being drawn into the instrument. A line-end filter (P/N 3015-3420) should be attached to the end of each sample intake line. Line-end filters should be placed 12" to 18" above the floor.

IMPORTANT: DO NOT block any of the zones. Unused zones may be disabled by setting their length parameter to zero feet in the zone setup screen.

Please refer to the earlier section *Suggested Location of Sampling Points* to learn more about where to place the ends of the sample intake lines.

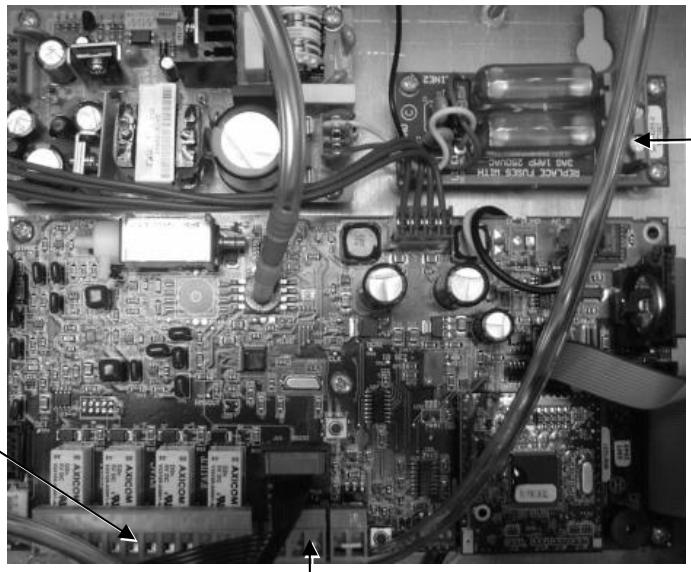
Interior Schematics



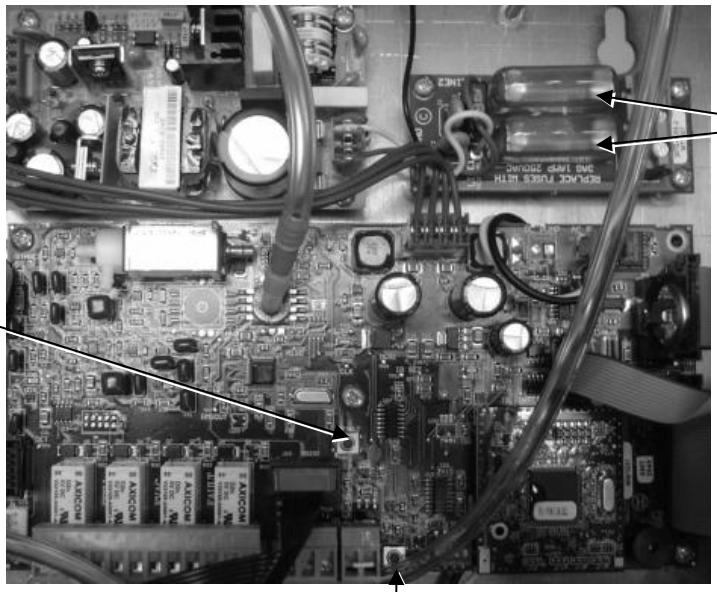
***NOTE: The plastic cable ties surrounding the air pump are to ensure safe handling during shipping. Please remove before operation.**

Reinstall a plastic cable around the air pump if the unit is shipped to Bacharach, Inc. for service or repair. This prevents damage during shipping.

AC Power / RS-485 / Relay Connector / 4-20 mAdc Current Loop



Switches / Fuses



Electrical Wiring

The HGM-MZ uses a universal power supply that is capable of accepting inputs of 100 to 240 VAC, 50/60 Hz. The monitor's power consumption is 20 Watts. It is highly recommended that the monitor be connected directly to the AC power source, preferably on its own circuit. The AC power connection should be completed with UL approved 3-conductor wire (minimum 16 AWG), rated 300 VAC at 105°C.

Locate a convenient service knockout and install electrical conduit in the typical manner.

Locate the AC Input Terminals and Ground Stud on the inside of the monitor . Secure the incoming AC power neutral (white/blue) and live (black/brown) wires to the LINE 1 and LINE 2 terminals.

Using the supplied crimp-on ring terminals, washers, and nuts, connect the incoming AC power ground wire (green) to the monitor's AC Input Ground Stud, and then install a separate wire between the ground stud and the GND terminal.

⚠ Warnings & Cautions

WARNING: *Electrical installation should be performed by a certified electrician, and must comply with all applicable NEC/CEC and local electrical safety codes.*

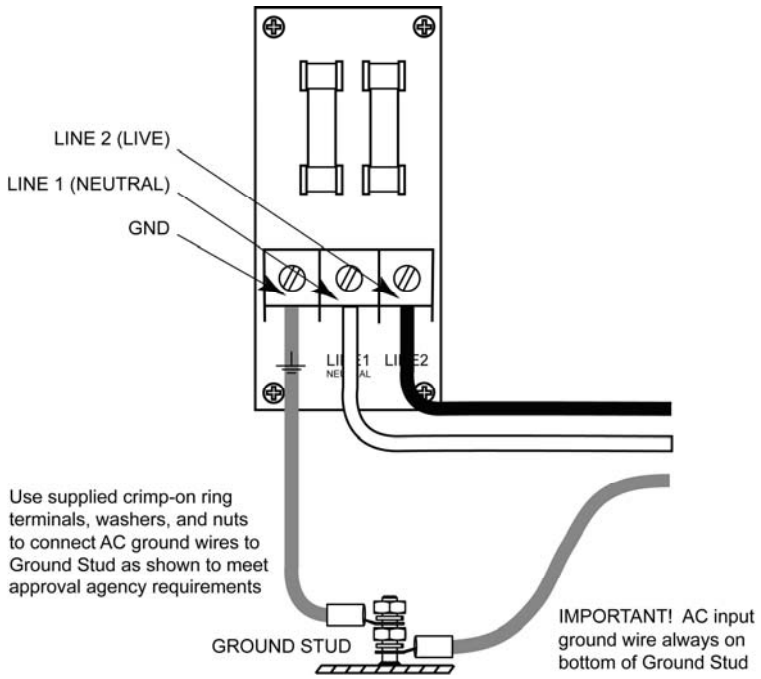
WARNING: *Copper conductors for connection to supply mains must be made in accordance with NEC/CEC and local codes.*

WARNING: *The AC power ground wire must first be connected to the monitor's ground stud. Under no circumstances should this monitor be operated without a protective ground. Doing so poses a potential shock hazard, and is also a violation of electrical safety standards applicable to this type of equipment.*

CAUTION: *Drilling holes in the HGM-MZ enclosure may damage the unit and will void the warranty. Please use the knockouts provided for electrical connections.*

A switch or circuit breaker rated 1.0 A, 250 VAC must be attached to the monitor's AC power leads. This switch must also be located in close proximity to the monitor, and be in easy reach of the operator. This switch should also be clearly marked as the monitor's main AC disconnect device. The circuit breaker or switch must disconnect all current-carrying conductors (i.e. Live and Neutral).

HGM-MZ AC Input Power and Ground Connections


LINE 2 (LIVE)
LINE 1 (NEUTRAL)
GND
Use supplied crimp-on ring terminals, washers, and nuts to connect AC ground wires to Ground Stud as shown to meet approval agency requirements
GROUND STUD
IMPORTANT! AC input ground wire always on bottom of Ground Stud

Connecting Communication Devices

Remote Display Module (HGM-RD) Connection

The HGM-MZ is connected to the HGM-RD using a shielded twisted pair instrument cable. The maximum distance between the farthest away HGM-MZ and HGM-RD is 4500 feet.

Use any of the remaining service knockouts to gain access to the interior of the monitor. The RS-485 communication wiring between the HGM-MZ and HGM-RD must be connected in the following manner:

Locate the RS-485 connector in the HGM-MZ (page 15). Connect one lead of a twisted shielded pair to the "B" connection point (the far right point), note the wire color. Connect the second wire to the "A" connection point (the middle), note the wire color. Connect the ground to the " ⏚ " connection point

Locate the RS-485 connector marked "TO MONITORS" in the HGM-RD (See this topic in the HGM-RD manual 3015-5157). This connector is located on the bottom of the HGM-RD PC board, second from the right. Make the wire run to the HGM-RD and connect the twisted shielded pair to the RS-485 "TO MONITORS" connector using the same color code as used on the HGM-MZ.

Integrating with Building Management Systems

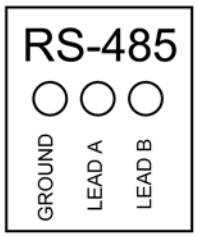
The HGM-MZ may be connected directly to a Building Management System using a shielded twisted pair cable. The cable from the Building Management System is connected to the RS-485 connector inside the HGM-MZ. MODBUS RTU is the standard communication protocol.

Use any of the remaining service knockouts to gain access to the interior of the monitor. Locate the RS-485 connector and remove it from the circuit board. Secure the wire leads to the connector orienting them as shown in the diagram below. Check to make sure that the polarity matches the wiring to the Building Management System. When you are through securing the connections, carefully plug the connector back onto the circuit board.

Larger Integrated Systems

You may also connect the HGM-MZ to a Building Management System through an HGM-RD. In this case, first connect the HGM-MZ to the HGM-RD as described above. Then, follow the instructions in the *Communications Connections* section of the HGM-RD manual (3015-5157) for information on how to connect the HGM-RD to a Building Management System.

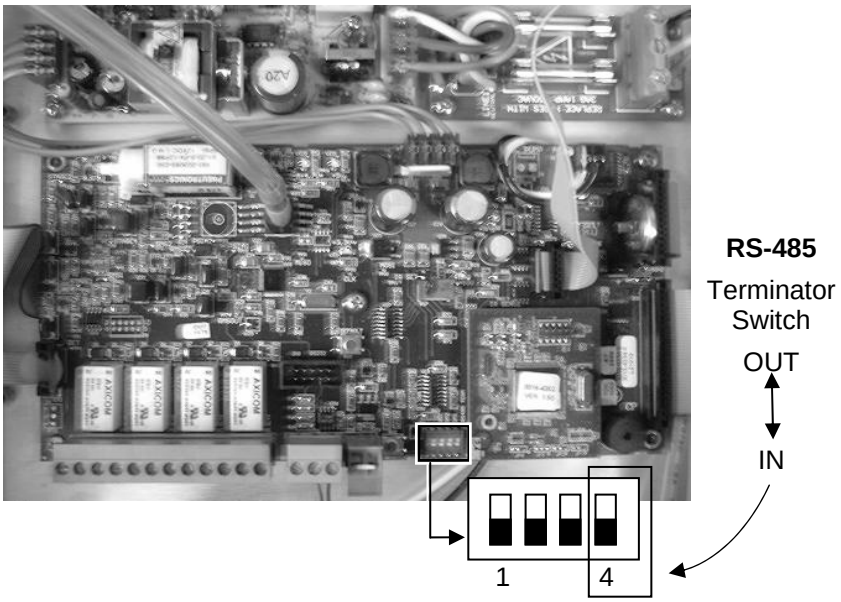
RS-485 Connector



Changing Terminator Switch Settings

The terminator switch is shipped from the factory in the terminated or “IN” position. This is the correct setting if the HGM-MZ is connected as a single device, or if it is the last device on the network chain. If the HGM-MZ is to be installed in the middle of a network, the terminator must be moved to the “OUT” position.

Locate the switch (#4) and determine its position. If it must be moved, slide the switch to the appropriate position. (Switches 1-3 are for service use.)



Personal Computer

(Refer to the “PC Software” section for details.)

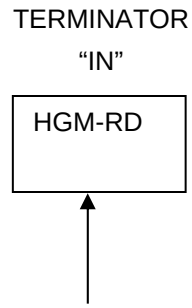
The HGM-MZ may be connected to a personal computer using the RS-232 interface on the left side of the enclosure.

Software will be provided upon request or as a download from:

http://www.bacharach-inc.com/downloads.htm

Multiple HGMs

Multiple HGM-MZs With HGM-RD

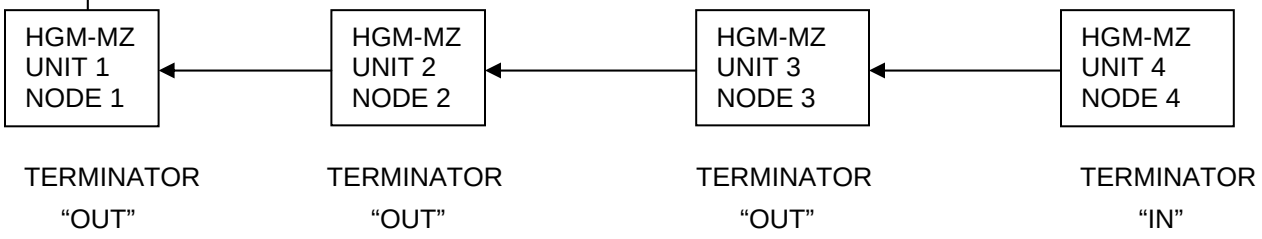


NOTE 1: The last HGM-MZ or HGM-RD on either end of the network must have its terminator in the "IN" position, and all other units must have their terminators in the "OUT" position.

NOTE 2: The total length of the RS-485 cable cannot exceed 4500 feet. (Use instrument cable 20 gage multi-strand shielded and twisted pair – similar or equal to Belden cable #8762.)

RS-485 Connections Between HGM-MZs

NOTE: The terminators in the HGM-RD and HGM-MZ Unit 4 must be in the "IN" position. The terminators in HGM-MZ units 1, 2 and 3 must be in the "OUT" position.



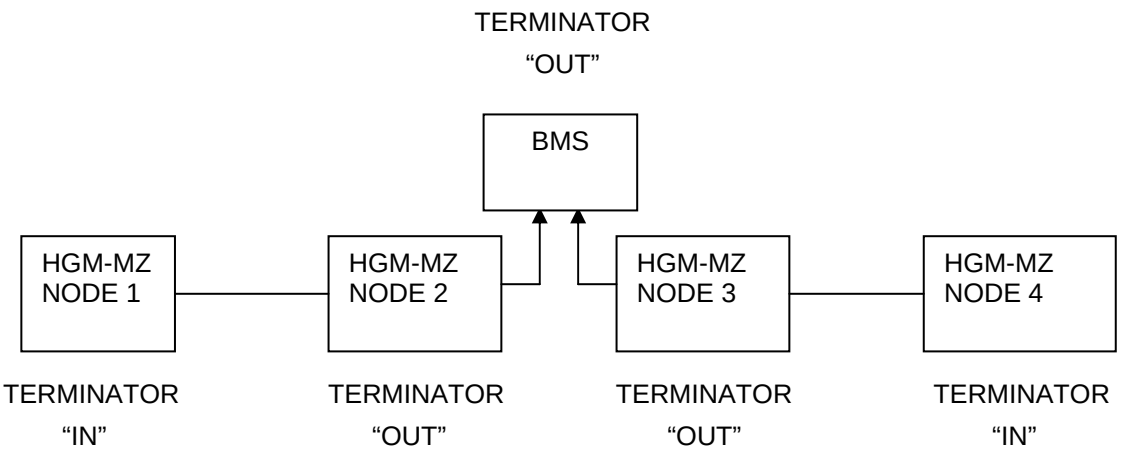
Connecting to a Building Management System

The HGM-MZ may be connected to a Building Management System via the RS-485 connector. The node address on each HGM-MZ may be set from "1" to "15" in order to identify itself to the Building Management System. Note that Building Management Systems set to a "0" or "1" address both respond to messages from the HGM-RD as address "1" therefore you should not have a unit set to "0" and another set to "1" on the same network.

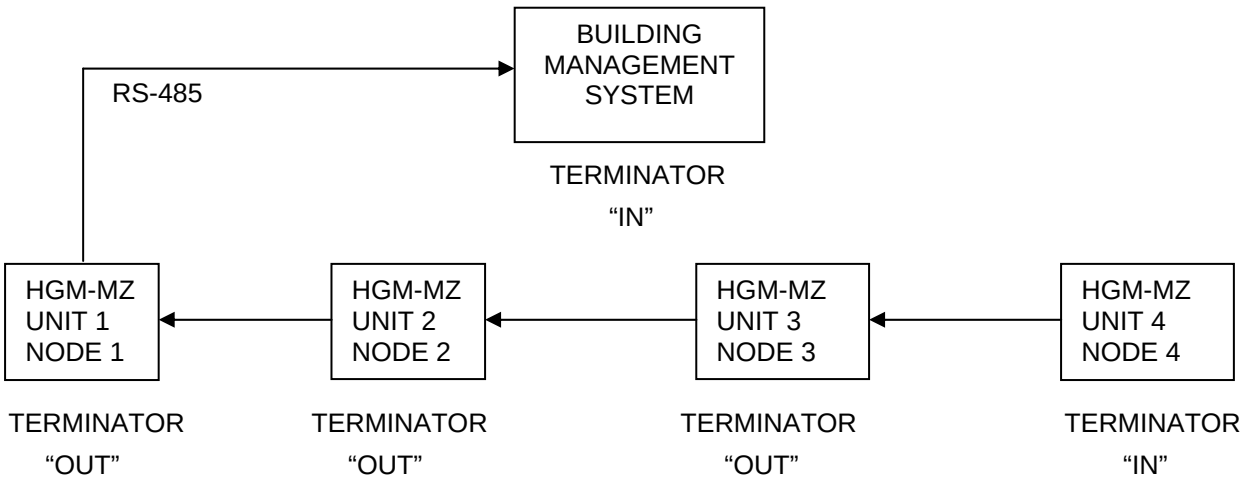
If the HGM-MZ network is connected directly to a Building Management System it **may not** be connected to the HGM-RD. However, the HGM-RD has two communication ports, an "upstream" port (labeled BMS) and a "downstream" port (labeled TO MONITORS). A BMS node may be connected to the up stream HGM-RD port while the downstream HGM-RD port talks to the HGM-MZs. In this case, the BMS is talking "through" the HGM-RD to the HGM-MZs, but not physically on the HGM-MZ/HGM-RD network.

NOTE: If the HGM-MZ is not at the end of the line in a series connection, then the terminator on the HGM must be set to "OUT." Also, each end of the series must have the terminator set to "IN".

Multiple HGM-MZs Connected to a Building Management System



Multiple HGM-MZs Connected to a Building Management System
Daisy Chain Fashion



PC Software

NOTE 1: The HGM-MZ is compatible with HGM300 PC software version 1.52 and higher. However, calibration data can only be edited on the front panel of the HGM-MZ , not through the PC software or RDM units.

NOTE 2: The PC software uses COM1 by default. Therefore, the interface cable should be connected to the port configured as COM1 on the PC. Also, no other software drivers or devices in the computer may control COM1 when the HGM-MZ software is in use. Alternatively, COM2 may be used by adding a space and the number 2 to the command line, c:\pc2HGM.exe 2, for example. When using a USB to serial converter, be sure it has been mapped to COM1 or COM2.

The connection is made through a standard "straight through" serial port connection. A three-wire connection is used (RXD, TXD, and GND). No hardware flow control is used. The HGM-MZ software automatically configures COM1 to match the HGM-MZ RS-232 communications parameters.

NOTE 3: Occasionally, the laptop connection will not connect properly and only two beeps are heard and the program times out. To resolve this, disconnect the RS-232 cable and cycle power on the HGM-MZ and the laptop. After both are operational, connect the RS-232 cable and start the software program.

1. Apply power to HGM-MZ and allow it to warm up.
2. Connect RS-232 interface cable to the PC and RS-232 port on the HGM-MZ.
3. Insert software disk into the PC.
4. Open the HGM-MZ software using Windows Explorer.
5. Upon start up, the program will immediately attempt to download data from the HGM-MZ, as indicated by several beeps.

   Navigate using your PC keyboard:

   - Use the **up, down, left and right arrow** keys to navigate through the screen options.
   - Use the **Enter** key to select options.
   - Use the **Esc** key to go back one step.

6. Go to EDIT. From the EDIT Menu, select SYSTEM. The HGM LOCATION becomes highlighted. Press **Enter** to move to the HGM TAG area. Use the **Backspace** key to remove the existing tag. Enter a new tag. Press **Enter** to return to LOCATION. Select the next item to be addressed. Note that you cannot change the "SN" or "FIRMWARE" items. Press the **Esc** key to return to the menu bar.

7. Go to EDIT. From the EDIT Menu, select ZONES. Select a specific zone to identify and set parameters. When REFRIGERANT is selected, scroll through the gas library to locate and select the gas type for that zone.
8. Setting the Alarms: Select EVAC LEVEL**.** Use the **Backspace** key to clear previous setting. Type in the new PPM level. Use the same method to set the spill level and leak level.
9. To close or bypass a zone: Set the DISTANCE to 0 feet.

   IMPORTANT: When a modified parameter (zone, system or calibration) is sent to the HGM-MZ, please wait for the computer software to indicate that the download is complete before continuing with any further edits.

Saving & Sending Programs

- When saving to your computer, the program will automatically add ".cfg" to the filename you have entered.
- To send a saved program to the HGM-MZ, open the program and connect the PC to the HGM-MZ. From the HGM, select SEND SETUP and press **Enter**. The saved program will be sent to the HGM-MZ.

Trend Data

Creating a trend data file must be done while connected to the HGM-MZ.

From the computer, select GET TREND DATA. Select the zone that you want to trend and press **Enter**. The trend data will appear in a list format. Press **Enter** again to access the file name screen. Type in the file name for that zone. Press **Enter.** The file will be saved as a text file that can be converted to an Excel file or printed as is.

NOTE: The TREND file must be saved Zone by Zone, with a filename per zone.

Converting the TREND Text File to a Microsoft Excel File

Open Excel and the desired file. Select "Delimited" format and "Space" as the delimiter. Select "General" as the column data format. The text file will display as an Excel file. When saving, change the file name extension to ".xls". Comments or notes may be added to this file as needed and saved.

Saving & Printing the HGM-MZ Software Screen, Alarm Log, Fault Log, or Diagnostic Screen

Open the software while connected to the HGM-MZ. After the software receives the program, open the desired screen. Use the **Alt** and **Print Screen** key combination on the PC keyboard to capture the image and paste it into a Word document. Save and print.

USB Type Laptops

Some laptops have USB ports and no RS-232 9-pin ports. A USB to serial converter or PCMCIA to serial converter will be required if a PCMCIA slot is available You will be required to purchase a PCMCIA card that provides an RS-232 output. We recommend the PCMCIA card manufactured by:

SEALEVEL SYSTEMS, INC.
155 TECHNOLOGY PLACE
P. O. BOX 830
LIBERTY, SC 29657
PHONE – 864-843-4343
www.sealevel.com

Part number: 2105 USB to RS232 or PC- SIO-232 PCMCIA CARD

A "straight through" RS-232 cable and a DB25 to DB9 adapter will be required to connect the laptop to the HGM-MZ.

Current Loop Interfaces

Optional 4–20 mAdc Outputs

Upon installation of the optional 4–20 mAdc Interface Board (page 14) (P/N 3015-5152), the HGM-MZ has the capability of providing dual 4-20 mAdc scrolling current loop outputs for connection to external monitoring devices. Loop outputs are powered internally. Do not use an external power supply as this can damage the loop card.

The interfaces are set up as follows:

Loop 1 indicates zone area

Loop 2 indicates PPM

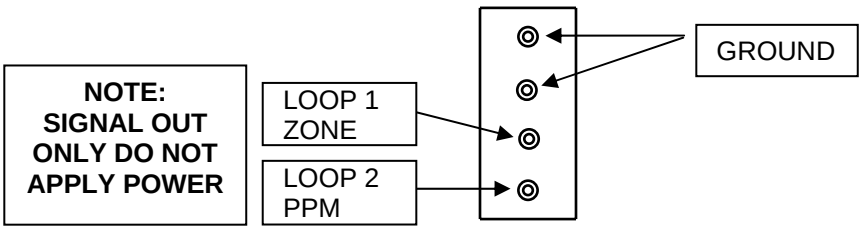
Connection

The external devices are connected to the HGM-MZ using a shielded dual twisted pair cable. Use any of the remaining service knockouts to gain access to the interior of the monitor. Locate the Dual 4–20 mAdc Output connector (page 14) and remove it from the circuit board. Secure the wire leads to the connector orienting them as shown in the diagram below. Check to make sure the polarity matches the wiring at the external device. When you are through securing the connections, carefully plug the connector back onto the circuit board.

NOTE: When one or both current loop outputs are not used, install a jumper wire between the ground and the unused loop terminal(s) to prevent the system from generating a current loop fault.

⚠ **CAUTION:** *The loop outputs have isolated grounds. Therefore the cable shield should be terminated at the receiver and **not** the HGM-MZ. The signal for both current loops must be returned to the HGM-MZ.*

Current Loop Connector



NOTE: The ground connections are common.

LOOP 1 = ZONE	LOOP 2 = PPM
5 mAdc = Zone 1	Default
6 mAdc – Zone 2	0.016 mAdc = 1 PPM
---	Scalable via Software
---	4 mAdc = 0 PPM
20 mAdc = Zone 16	20 mAdc = 1000 PPM

Connecting External Alarms

Overview

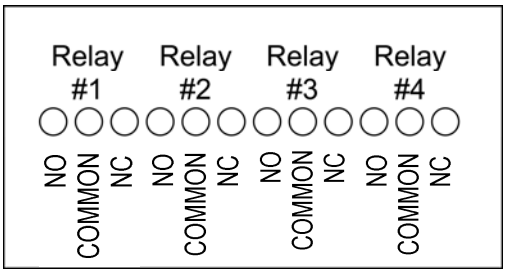
Each HGM-MZ includes 4, Form C, SPDT relays. The contacts are rated 2A at 250 VAC and 2A at 30 VAC. These relays are used for the connection of external alarm devices. The relays are factory assigned to the following conditions:

Relay #1 Leak
Relay #2 Spill
Relay #3 Evacuate
Relay #4 Fault

Connection

Use the AC conduit or any of the remaining service knockouts to gain cable access to the interior of the monitor. Locate the relay connector (page 15) and remove it from the circuit board. Secure the leads to the connector orienting them as shown in the diagram below. When you are through securing the connections, carefully plug the connector back onto the circuit board.

HGM-MZ Relay Connector



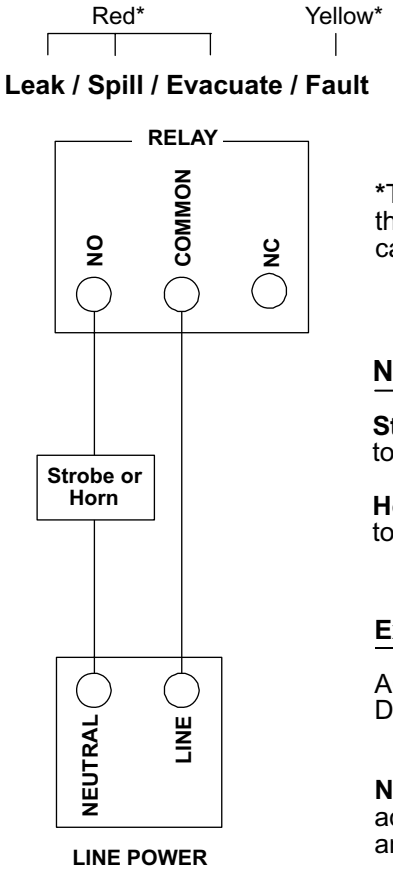
NOTE: Each relay may be connected as normally open (NO), or normally closed (NC).

The relay contacts are rated 2A at 250 VAC and 2A at 30 VAC.

Latching / Non-Latching – refer to page 26 to select Alarm Ack Mode.

Alarm power source – power for the alarm devices connected to the relay contacts may be supplied from the AC Power Input Connector (page 14).

Typical HGM-MZ Relay 1 and Relay 2 Wiring



***The colors correspond to the LEDs on the front of the case.**

Normal configuration:

Strobes are usually connected to the Leak relay (#1)

Horns are usually connected to the Spill relay (#2).

External Power:

AC < 250V
DC < 20W

Note: The device does not power accessories; power must come from an external source.

Jumper the 'Neutral' of the input power connector to the 'Common' on the relay block. Connect one end of strobe or horn to the 'NO' of whichever level of alarm is appropriate for application. The other end of strobe or horn is connected to the 'Line' of the input power connector (5 A maximum).

3 Setup Programming

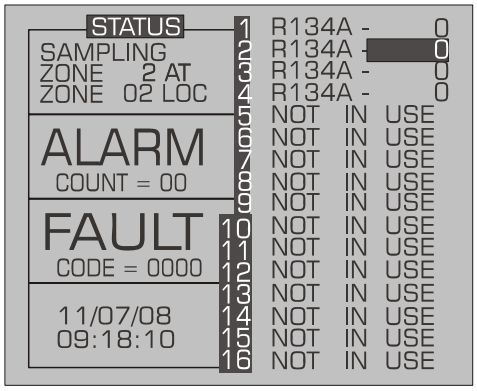
Display Screens

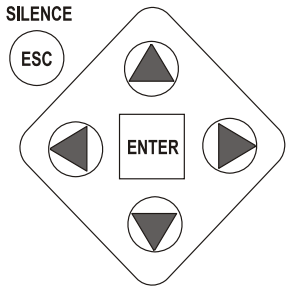
Initial Power Up

When the HGM-MZ is powered up, all front level panel LEDs will illuminate and a splash screen will appear, displaying the monitor's firmware version level. After a moment, the **Warm Up** screen will be displayed and the green **MONITOR ON** light will blink.

After a 15 minute warm up cycle, the **MONITOR ON** light will glow steadily and the **Data Display screen** will be displayed. (See Appendix C for an overview map of the screens in the system.)

Data Display Screen



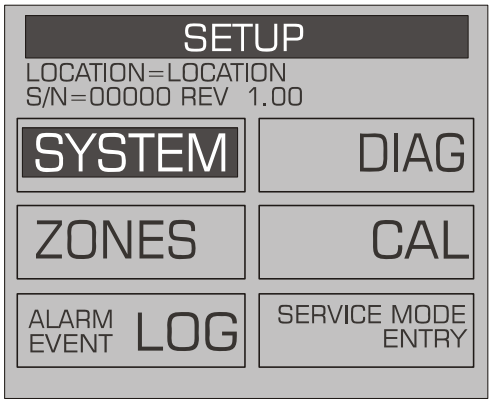


- Use the **Arrow** keys for multi-directional movement in making selections and moving the cursor.
- Use the **Enter** key to initiate and complete a selection.
- Use the **Escape** key to go back during programming or to silence an alarm in alarm mode.

Navigating to the 1st Setup Screen

- Use the UP/DOWN arrow keys to select the first text box to access the **Setup** screen**.**
- Press **ENTER** to select.

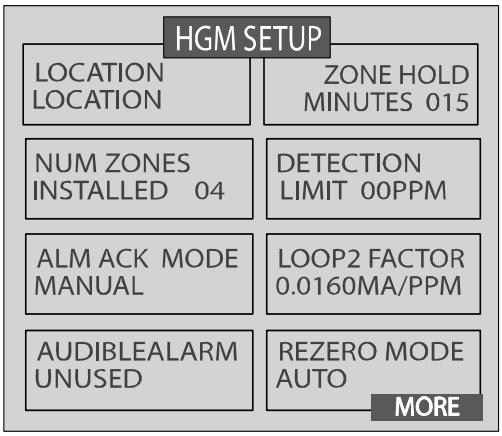
HGM System Setup Screen #1



Navigating to the 2nd Setup Screen

From **HGM System Setup Screen #1,** select the **SYSTEM** option to go to **HGM System Setup Screen #2.** Select the ESC key to return to the **System Setup Screen #1**.

HGM System Setup Screen #2



Location

This is the name you assign to the HGM-MZ to identify its location. It may have up to 12 alphanumeric characters.

1. Press the ENTER key to adjust the setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual characters.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Number of Zones Installed

IMPORTANT: Do not change the number of zones to deactivate unused zones. Changing the number of installed zones is only necessary when manifold blocks are added or removed. Go to the individual zone that you wish to disable and set its distance to zero.

1. Press the ENTER key to adjust the number.
2. Use the UP/DOWN cursor keys to modify the number.
3. Press ENTER to accept the new number or ESC to revert to the previous setting.

Alarm Ack Mode

This function programs the relays in the HGM unit for latching or non-latching operation.

1. Press the ENTER key to adjust the setting.
2. Use the UP/DOWN cursor keys to toggle between settings.
   - AUTO – Non-latching (Alarm relay will automatically de-energize when the gas level drops below its alarm point.)
   - MANUAL – Latching (Alarm relay remains energized, and will not release until the alarm condition has been manually acknowledged. Refer to *Acknowledging Alarms* on Page 34.)
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Audible Alarm

This parameter selects the function of the HGM-MZs internal audible alarm device.

1. Press the ENTER key to adjust the setting.
2. Use the UP/DOWN cursor keys to select unused, monitor on, evacuate, spill, leak, fault, or alarm.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Zone Hold Mode

A zone can be placed on hold and continuously monitored for a length of time determined by the Zone Hold Time value. To place a zone on hold, select the zone at the top level screen, then press and hold down the ENTER key until the unit beeps. The word “HOLDING” will appear in the status box.

While in the hold mode, further investigation of the zone’s status can be made by navigating to that **Zone’s Setup Screen #1**. To release the zone from the hold mode, press and hold down the ENTER key until the unit beeps and the screen display returns to normal.

Zone Hold Time

Sets the length of time a zone will be monitored when the zone hold feature is activated. The default is 15 minutes. The range is 1 to 999 minutes.

1. Press the ENTER key to adjust this setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual numbers.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Detection Limit

This is essentially a squelch setting that instructs the instrument to interpret PPM readings below the designated level as 0. The range is 1 to 99 PPM.

1. Press the ENTER key to adjust the setting.
2. Use the UP/DOWN cursor keys to modify the setting.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Loop2 Factor

This sets the PPM scale factor for current loop number 2. To calculate the current output, multiply the scale factor by the PPM and add 4. For example, at the default scale factor of 0.016, a measurement of 100ppm would generate a current output of 5.6 mAdc. The current output cannot exceed the 20 mAdc capacity of the interface.

1. Press the ENTER key to adjust the setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual characters.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Re-Zero Mode

This parameter defines the frequency at which the instrument re-zeros the optical sensor.

1. Press the ENTER key to adjust the setting.
2. Use the UP/DOWN cursor keys to toggle between settings.

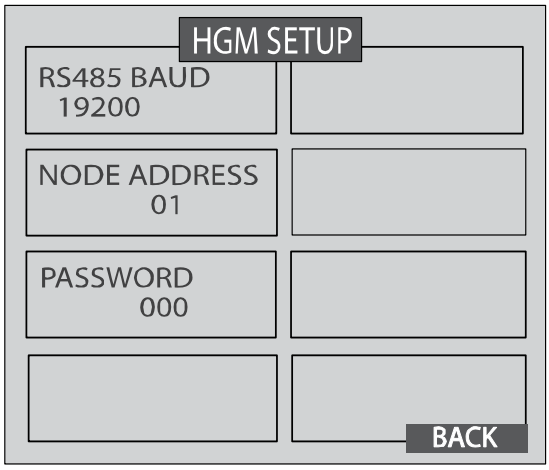
   AUTO – Sets the instrument to re-zero every 10 minutes.

   ZONE CHANGE – Sets the instrument to re-zero at each zone change. This is the most accurate setting, but increases the time interval between measurement cycles.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Navigating to the 3rd Setup Screen

From **HGM System Setup Screen #2**, select the MORE option to go to **HGM System Setup Screen #3**. Select the BACK option to return to **HGM System Setup Screen #2**.

HGM System Setup Screen #3



NOTE: The **RS485 BAUD** rate text will be replaced by “Service Timeout” when in Service Mode.

Service Timeout

Displayed in Service Mode. Sets the length of time the Service Mode is in effect. Stops the monitor for up to 300 minutes (5 hrs) to allow for servicing the unit.

1. Press the ENTER key to adjust the setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual numbers.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Node Address

Each HGM on the network must has a distinct node address. The node address may be set from 1 to 64.

1. Press the ENTER key to adjust the setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual numbers.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Password

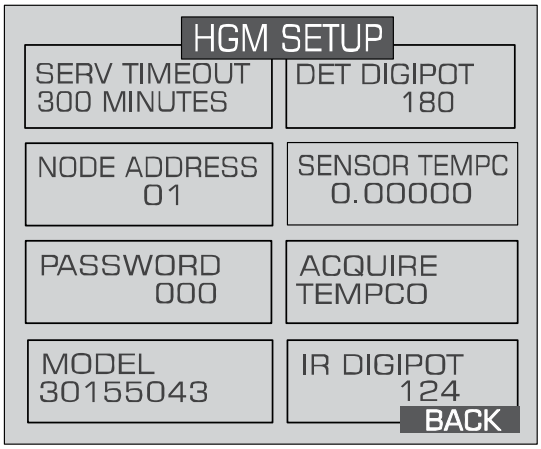
This field is used to define a system password. The default setting is 000, which provides no password protection.

1. Press the ENTER key to adjust the password.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual alphanumeric characters.
3. Press ENTER to accept the new password or ESC to revert to the previous setting.

Accessing Additional Features

Several additional features can be viewed on the System Setup Screen #3 when the HGM is placed in service mode (refer to *Service Mode* on page 43). While in service mode, the user can identify the model number, set digipot values and sensor temperature, and acquire the temperature coefficient.

System Setup Screen #3 (Service Mode)



DET Digipot

The DIGIPOT function allows *manual* and a more precise adjustment of the digital potentiometer, which controls the voltage of the IR Detector. The DIGIPOT is auto tuned at every power up.

1. Press the ENTER key to adjust the setting. Once the option is selected the screen will also display the voltage.
2. Use the UP/DOWN cursor key to modify the Digipot value.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Sensor Temperature Coefficient

1. Press the ENTER key to adjust the setting.
2. Use the UP/DOWN cursor key to modify the temperature value.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Acquiring Temperature Coefficient (For factory use only)

Press the LEFT and RIGHT arrow buttons simultaneously to return to the previous screen.

IR Digipot

This option will indicate the electrical parameters of the infrared emitter

4 General Operation

Functional Overview

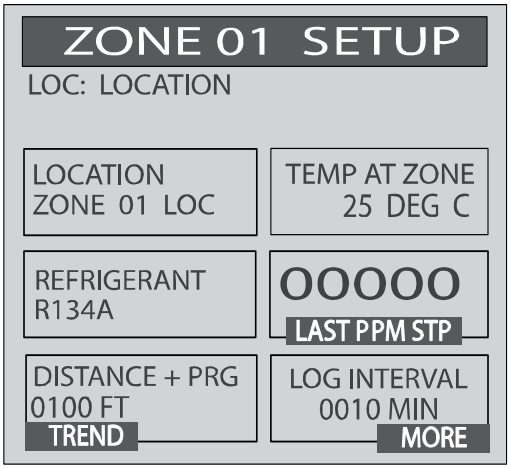
Normally each HGM-MZ will sequentially perform measurements on its active zones without user input. The total time it takes an HGM-MZ to complete a measurement cycle is directly proportional to the number of active zones and the physical length of the air lines. Monitors linked together on a network operate independently of each other and consequently complete their respective measurement cycles at different rates.

The HGM-RD operates by polling the network approximately once every 12 seconds to determine the current status of the HGM-MZ monitors. If more than one HGM-MZ is connected to the network, it will sequentially poll each monitor for its status. As a practical matter this simply means that the more complicated the network, the longer it will take the HGM-RD to update the status information for all zones.

The Zone Screen

From **System Setup Screen #2**, scroll down to select the **ZONES** option.

Zone Setup Screen #1



Location

This is the name you assign to the HGM-MZ to identify its location. It may have up to 12 alphanumeric characters.

1. Press the ENTER key to adjust the setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual characters.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Refrigerant Type

This displays the kind of refrigerant the HGM-MZ is detecting.

1. Press the ENTER key to adjust the setting;
2. Use the LEFT/RIGHT cursor keys to select the type of refrigerant you want the device to detect.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Distance

This displays the combined length of the sample tubing plus any tubing on the exhaust port. Total length should not exceed 1,200ft.

1. Press the ENTER key to adjust the setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual characters.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Zone Temperature

This displays the air temperature at the zone being sampled.

1. Press the ENTER key to adjust the setting.
2. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual characters.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Current Detection Reading

This reading displays the current PPM STP level of the selected refrigerant.

Log Interval

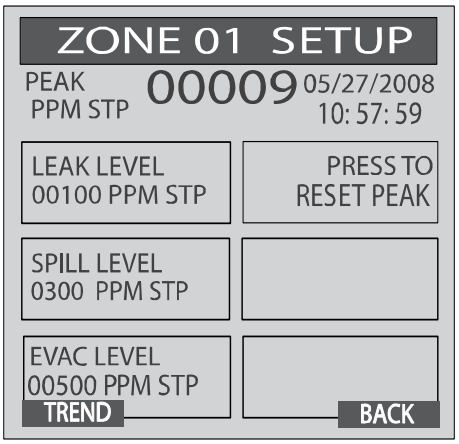
The HGM-MZ retains a data log of 100 measurements for each zone. The log interval is the number of minutes from 1 to 1440 between each log point. This parameter can be changed from **Zone Setup Screen #1** (page 32).

The default setting for this parameter is 1440 minutes (24 hours). If the log interval time is set to 0, then a measurement is recorded in the trend log after *every measurement cycle*. Therefore, after the trend log is filled, it will contain the last 100 measurement points for a zone. If you want the data logged less frequently, increase this value. It is important to remember that cycle time is dependent on many factors, including the number of zones monitored, input line length, and the run zeroing mode selected. Before changing this value it may be useful to first review the log data using the **Trend Screen** to determine the nominal cycle time.

Navigating to the 2nd Zone Screen

Select the **MORE** option at the bottom right side of the screen to continue to the next screen containing more options.

This screen displays the peak PPM value in the upper left side of the screen.



Leak Level

This is the concentration level in PPM that will activate a leak alarm condition.

1. Press the ENTER key to adjust the value.
2. Use the UP/DOWN cursor keys to modify the setting.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

NOTE: This value must be less than the spill level.

Spill Level

This is the concentration level in PPM that will activate a spill alarm condition.

1. Press the ENTER key to adjust the value.
2. Use the UP/DOWN cursor keys to modify the setting.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

NOTE: This value must be less than the evacuate level and greater than the leak level.

Evacuation Level

This is the concentration level in PPM that will activate an evacuate alarm condition.

1. Press the ENTER key to adjust the value.
2. Use the UP/DOWN cursor keys to modify the setting.
3. Press ENTER to accept the new entry or ESC to revert to the previous setting.

NOTE: This value must be greater than the spill level.

Re-Setting the Peak PPM Value

Pressing this key resets the current peak PPM level stored in memory and displays it at the top of the screen.

Alarm Conditions

When an alarm condition is detected anywhere on the network the red ALARM LED will glow. Additionally, an external alarm device may activate and an audible alarm may sound if those features have been enabled.

An inverse flashing box indicates an alarm condition in the affected zone.

You can further investigate the status of the affected zone by pressing the **ALARM** option on the **Data Display Screen**.

Fault Conditions

If a system malfunction occurs, the yellow FAULT LED will glow. Additionally, an external alarm device may activate and an audible alarm may sound if those features have been enabled.

Alarms

Functional Overview

If the PPM level for any zone exceeds its designated spill, leak, or evacuate thresholds, an alarm condition will be created. Once the HGM-MZ completes a measurement cycle in the affected zone the alarm condition will be indicated. At that time the red ALARM LED on the HGM-MZ will glow. Additionally, an external alarm device may activate and an audible alarm may sound if those features have been enabled.

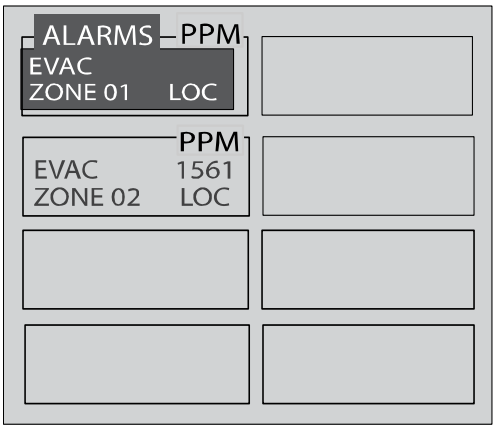
The next time the HGM-RD polls the affected monitor its red ALARM LED will glow. Additionally, an external alarm device may activate and an audible alarm may sound if those features have been enabled.

The alarm condition may or may not have to be acknowledged for the system to return to normal operation.

Responding to Alarms

An operator can respond to the alarms by accessing the **Alarm Summary Screen.** Navigate to this screen by selecting ALARM on the first (**Data Display**) screen.

Alarm Summary Screen



The **Alarm Summary Screen** displays a list of all alarm conditions pending across the network. The screen is divided into 8 boxes, and each box represents a single alarm. If more than 8 alarms are pending, the MORE option will be displayed at the bottom of the screen to permit access to that additional information.

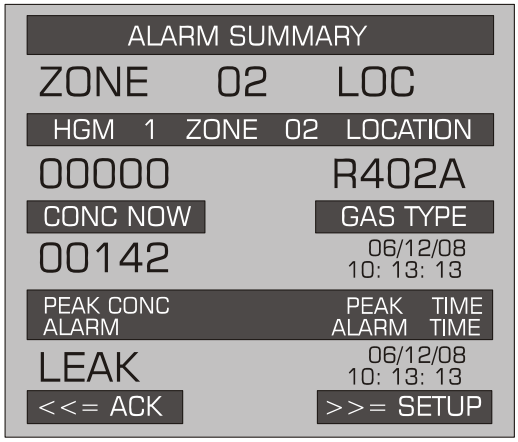
Each box displays the zone number, zone name, and the current PPM reading. A flashing box indicates an alarm that has not been acknowledged. A static box represents an alarm that has been acknowledged but has not yet been cleared from the system.

The Alarm Data Log can be reset by pressing a combination of the ENTER and RIGHT arrow buttons while viewing the log.

Alarm Detail Screen

To further investigate an alarm, press the ENTER key to go to the **Alarm Detail Screen**.

Alarm Detail Screen



The **Alarm Detail Screen** displays more comprehensive information about the nature of the alarm including:

- Complete location information
- Gas type and current concentration (CONC NOW)
- Peak concentration and peak time
- Type of alarm, alarm time, and date

This screen provides the following navigation options at the bottom of the display:

ACK Using the left arrow key, acknowledges the alarm as described in the next section

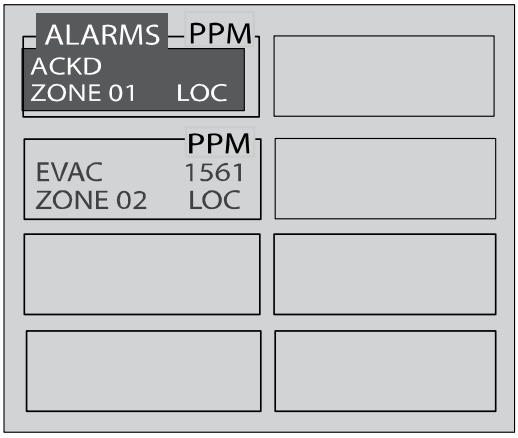
SETUP Using the right arrow key, navigate to the **Zone Setup Screen #1.** This enables review of the zone setup parameters and access to the **Trend Screen.**

Use the ESC button on the front case to go back to the previous menu.

Acknowledging Alarms

Each pending alarm may require, depending upon selected alarm mode, acknowledgment before the system returns to normal operation (refer to *Alarm Ack Mode* on page 26). To acknowledge an alarm, navigate to the **Alarm Detail Screen** and select the ACK option as previously described. You will then be returned to the **Alarm Summary Screen** and the box associated with that alarm will no longer be blinking, indicating that the alarm has been acknowledged. Repeat this procedure to acknowledge any remaining alarms.

Alarm Summary Screen (Acknowledge Mode)



Once all the alarms associated with a given HGM-MZ are acknowledged, its RED LED will turn off and any external alarms connected to the HGM-MZ relays will de-activate. All pending alarms across the entire network must be acknowledged before the HGM-RD returns to normal operation. Once that occurs, its RED LED will turn off and any associated external alarms connected to the HGM-RD relays will de-activate.

Keep in mind that the system will continue to generate new alarms if PPM values above the alarm thresholds are detected.

Silencing an Alarm

When alarms are active, the ESC key functions as a silence key. During an active alarm and with the main screen displayed, press the ESC key. This will generate a prompt to "PRESS ENTER TO CONFIRM SILENCE". When ENTER is pressed, the LEAK relay will open and the internal audible alarm (if enabled) will turn off. In this way, when the LEAK relay is used to operate strobes and horns, they can be quickly silenced without effecting the SPILL or EVAC, which may be controlling fans or ventilation equipment. This 'silence' mode will be indicated by a reverse flashing 'S' in the alarm window. The 'silence' mode will be automatically canceled if the alarm condition of any zone changes by clearing or elevating to a higher level.

System Faults

Functional Overview

If a system malfunction occurs, the yellow FAULT LED will glow. Additionally, an external alarm device may activate and an audible alarm may sound if those features have been enabled (pages 25 & 29).

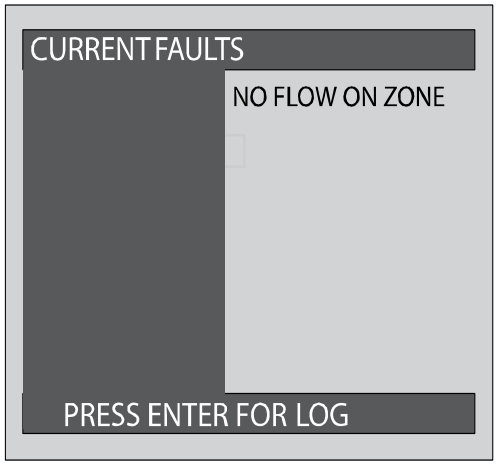
The next time the HGM-RD polls the affected monitor its yellow FAULT LED will also glow. Additionally, an external alarm device may activate and an audible alarm may sound if those features have been enabled (pages 25 & 29).

Depending on the nature of the fault, the HGM-MZ may or may not continue to operate normally. Under a non-critical fault condition, the HGM-MZ will continue to measure and log data, but some peripheral functions may be compromised. Under a critical fault condition, action is required for the HGM-MZ to operate normally. The table on the following page lists the various fault conditions and explains what action should be taken to correct the problem.

Navigating to the Fault Screen

Displayed on the initial **Data Display** Screen is a **Fault** option. Scroll down with the cursor key and select this option, which will introduce you to the **Fault Screen**.

Fault Screen



Critical Faults

- **NO FLOW ON ZONE** – Go to the **Data Display Screen** and press the FAULT key. This will display a "NO FLOW" message in each individual zone affected. Check for a blockage in the air sample line or at the line end filter. Once the blockage has been cleared, the HGM-MZ will return to normal operation after the zone has been sampled. **NOTE:** *This can take some several minutes since it is dependent upon how many zones there are and their lengths.* The HGM-MZ will clear the fault the next time it polls the effected zone and the HGM-RD will return to normal operation the next time that it polls the HGM-MZ.
- **NO FLOW ON PURGE** – Check the purge line for a blockage. Verify that the length of the purge line and exhaust line do not exceed 500 feet in length.
- **NO FLOW DETECTED** – Check for proper pump operation. Examine the hydrophobic filter for contaminants or water on the input side. If the input side is gray, a contaminant is present and the filter must be replaced. To drain, remove the tubing from both sides of the filter and tap the tubing on a hard surface to dislodge the contents.
- **CLIPPING FAULT** – The detector voltage may be out of tolerance. Refer to the **Diagnostic Screen** for the DET voltage, AVE voltage and ZERO voltage. Call the factory with this information for further instructions.
- **REZERO VOLT TOL** – The detector output voltage is out of tolerance. Refer to the **Diagnostic Screen** and contact the factory for assistance.
- **TRIGGER FAULT** – No trigger from IR source pulser. Contact factory with all information from the DIAGNOSTIC SCREEN for further instructions.

Non Critical Faults

- **BOX TEMP FAULT** – Enclosure's internal temperature is outside normal range (or IR sensor has failed). Check the installation to verify that the monitor is not being subjected to extreme temperatures. Verify that the ventilation holes are not obstructed. Refer to the **Diagnostic Screen** for the ZERO temperature, BNCH temperature and BOX temperature. Call the factory with this information for further instructions.
- **BENCH TEMP FAULT** – Optical bench is outside of normal operating range (or sensor has failed). Check the installation to verify that the monitor is not being subjected to extreme temperatures. Check the **Diagnostic Screen** for the ZERO temperature, BNCH temperature and BOX temperature. Call the factory with this information for further instructions.
- **PRESSURE SENSOR** – Manifold pressure is outside normal operating range (or sensor has failed). Check the **Diagnostic Screen** record ALL data. Call the factory with this information for further instructions.
- **LOOP FAULT** – This would only be displayed if the dual 4-20 mAdc option was installed and one or both current loops are open. Check the wiring to load/monitoring circuit on both 4-20 mA loops.
- **CONFIG FAULT** – There is an error in **HGM Setup Screen #2** – Number Zones Installed field, or in **RDM Setup Screen #1** – Number of HGMS on Network field. Check that the number of zones installed for each HGM unit and the number of HGM units on the network are properly programmed. Check to ensure that the manifold solenoid cable connector in each HGM unit is securely fastened to its terminal connector. Check for an illegal parameter. If necessary, reset to the factory default settings.

Reset to Factory Default Settings

IMPORTANT: Performing this function wipes out all program parameters, alarms, faults, trends and log files.

Resetting the HGM-MZ –

1. Press and hold down the UP and DOWN arrow keys on the HGM-MZ (page 15)
2. Cycle AC power OFF then ON
3. Hold the keys until the second beep is heard
4. The screen will indicate "This unit has been reset to factory default conditions"
5. Release the keys
6. Reprogram the HGM-MZ as described in the *HGM-MZ – Setup Programming* section on page 25

Clearing System Faults

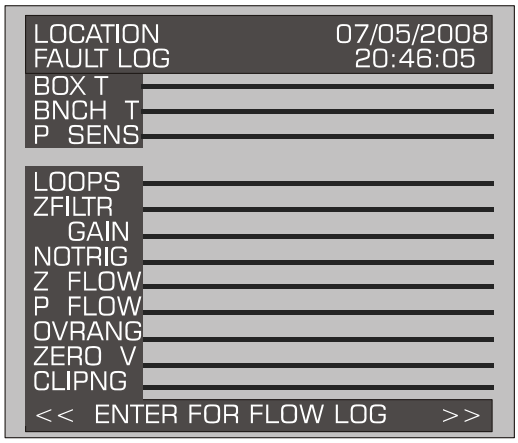
If the fault condition is associated with an HGM-MZ, the monitor will return to normal operation soon after the problem is corrected. At that time the YELLOW LED will turn off and any external alarms connected to the monitor's alarm relays will also turn off. The HGM-RD will return to normal operation the next time it polls the affected HGM-MZ monitor.

Once the system malfunction has been corrected it may take some time for the fault condition to clear completely. If the fault is associated with a specific zone, the HGM-MZ must first cycle back to the affected zone before it returns to normal operation. At that time the YELLOW LED will turn off and any external alarms connected to the monitor's alarm relays will also turn off. The HGM-RD will return to normal operation the next time it polls the affected monitor.

Viewing Fault Log

A data log of the last 20 fault conditions is retained in memory. On the **Fault Screen,** select the LOG option to view a display of the fault log.

Fault Log Screen



This screen lists potential fault conditions in the left column and displays a check mark indicating which problems were associated with each fault condition as represented by the vertical cursor bar. As you move the bar horizontally using the LEFT/RIGHT cursor keys, the date and time the fault condition was detected is displayed in the upper right hand corner of the display window.

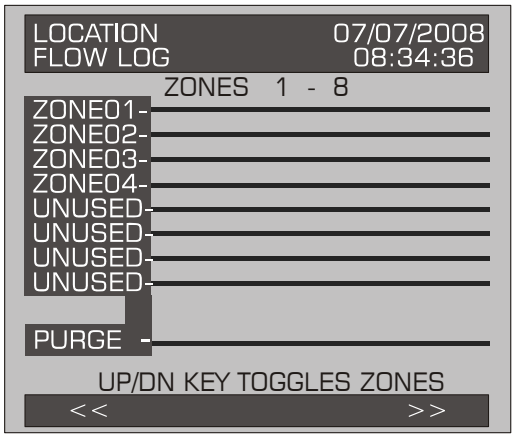
Anytime the fault status changes, there is an entry in the fault log, both when the fault occurs and when it is cleared.

The Fault Log can be reset by pressing a combination of the ENTER and RIGHT arrow buttons while viewing the log.

Viewing Flow Log

On the Fault Log screen, press ENTER to access the Flow Log screen. The Flow Log displays the last 20 flow events for all zones and the purge port.

Flow Log Screen



This screen lists the zones in the left column and displays flow data. Use the UP/DOWN buttons to scroll through the zones and the LEFT/RIGHT to scroll through the log data. As you move the bar horizontally, the date and time of the condition is displayed in the upper right hand corner.

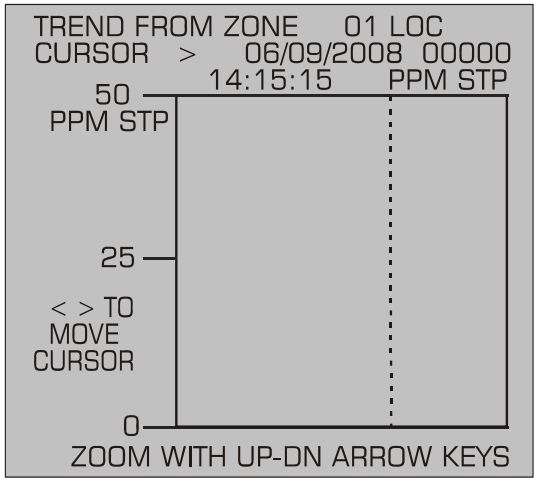
The Flow Log can be reset by pressing a combination of the ENTER and RIGHT arrow buttons while viewing the log.

The Trend Screen

Navigating to the Trend Screen

From the **Zone Screen**, select the **Trend** option on the bottom left side. This will open the **Trend** screen.

Trend Screen



The trend graph opens with the cursor located over the most recent data point. Use the LEFT/RIGHT cursor keys to move the cursor to different data points. Holding a key down will cause the cursor to move rapidly across the screen. As you move the cursor position, the date and time of that reading, along with the PPM value, are displayed at the top of the screen above the graph. The trend graph is automatically scaled to accommodate the largest PPM value displayed. The ZOOM OUT and ZOOM IN options allow you to adjust the vertical scale of the graph.

The trend data is stored on a first-in, first-out basis. After 100 trend values have been stored the 101st value will replace the first value stored. Therefore, in normal operation, when entering trend mode the cursor will be located at the most recent data point. The data points to the left of the initial cursor location will be the next most recent. The data point to the right will be the oldest data point in the buffer and will be over written by the next data point.

The Trend Data Log can be reset by pressing a combination of the ENTER and RIGHT arrow buttons while viewing the log.

When finished, press the ESC key to revert to the previous screen.

The Calibration Screen

Overview

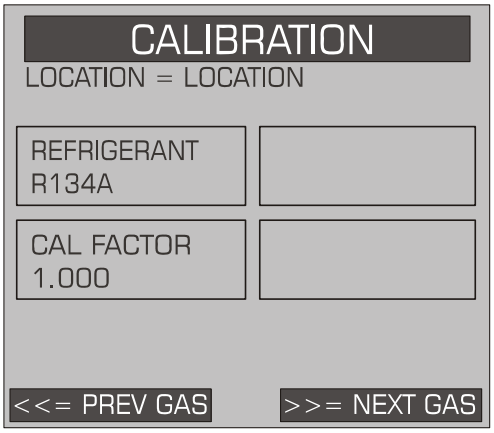
The **Calibration Screen** is used to adjust the calibration factor for each refrigerant gas. It is also used to program the instrument for new gasses.

IMPORTANT: Changing information on CAL FACTOR will VOID the factory calibration. Typically, the unit will remain within the factory-calibrated accuracy indefinitely and no calibration is required. Complex software algorithms adjust for temperature drift, IR source aging, and pressure changes in order to keep the unit within factory accuracy specifications.

Navigating to the Calibration Screen

On the System Setup screen, select the Calibration option (**CAL).**

Calibration Screen



Adjusting Calibration Factor

The factory default cal factor for standard units is 1.000. This value may be different if the high accuracy option is ordered.

Proceed as follows to adjust the current calibration factor:

1. Use the PREV GAS or NEXT GAS options to scroll through the list of refrigerants until the gas you wish to work with is displayed.
2. Select the CAL FACTOR option to edit the value.
3. Use the LEFT/RIGHT cursor keys to move across the entry field and the UP/DOWN cursor keys to modify the individual numbers.
4. Press ENTER to accept the new entry or ESC to revert to the previous setting.

Calibration Procedure

The CAL FACTOR is determined by sampling a known dilution of the type of refrigerant gas to be sampled. The sample must be prepared to less than half the desired accuracy, and the concentration must be corrected for ambient temperature and pressure at the time of measurement.

Calibration is best performed at or near full scale (1,000 PPM). It can, however, be done at any concentration, and ideally in the range where maximum accuracy is desired down to, but not below, 100 PPM.

A cylinder of refrigerant gas at a certified PPM level must be used to assure sampling occurs at ambient conditions. A minimum sample size of 5 liters is required.

The HGM should be operating for at least one hour prior to performing a calibration.

Prepare the HGM-MZ for sampling by initially setting its CAL FACTOR to 1.000. Next, set up the HGM-MZ for a logging interval of zero minutes, and place the HGM-MZ in its zone hold mode for the zone you wish to use for calibration purposes.

Connect the sample bag directly to the intake port for the zone you have set up and allow the HGM-MZ to sample the entire bag. When sampling is complete, view the trend data for the zone used to sample. Read the measured PPM by placing the cursor on the spikes cause by the sample. If the bag was large enough for multiple samples, average the most stable ones.

The new CAL factor is computed by dividing the known gas value by the measured value. Typically this value will be between 0.95 and 1.05. This value is stored in non-volatile memory.

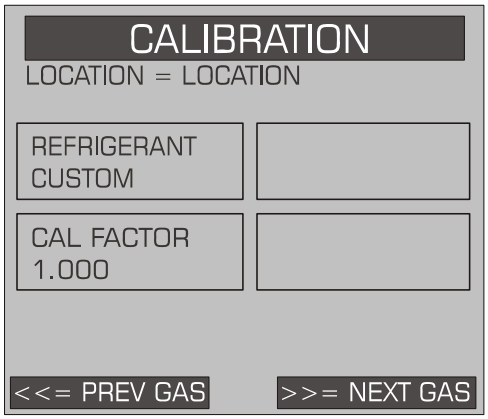
Programming New Gasses

As new refrigerants come into use the HGM-MZ allows the addition of these new gases to its on-board refrigerant gas library. At the end of the gas library list is an option labeled CUSTOM for adding new gases. From the **Calibration Screen** use the LEFT/RIGHT arrows to select CUSTOM from the list of refrigerants. Next, press ENTER, and use the UP/DOWN arrow keys to enter the calibration factor. The selection of the matching gas and CAL factor is performed by Bacharach by analyzing the new refrigerant. Once the matching gas is determined, field calibration is possible by using the same procedure as for other refrigerants. When the new gas entry is complete simply setup the appropriate zone for CUSTOM.

Program the instrument for a new gas as follows:

1. From the **Calibration Screen**, use the PREV GAS or NEXT GAS options to scroll through the list of available choices until the CUSTOM option is displayed.

Custom Gas Screen



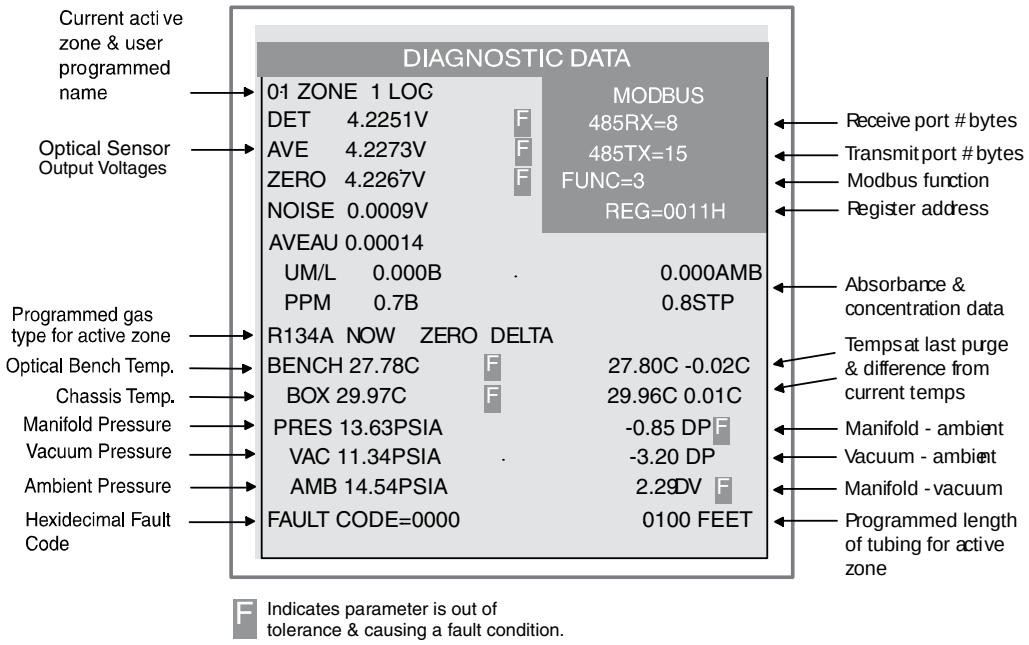
2. Select the CUSTOM option. Press ENTER to accept the new entry or ESC to revert to the previous setting.
3. Enter the new CAL Factor as received from Bacharach.

The Diagnostic Screen

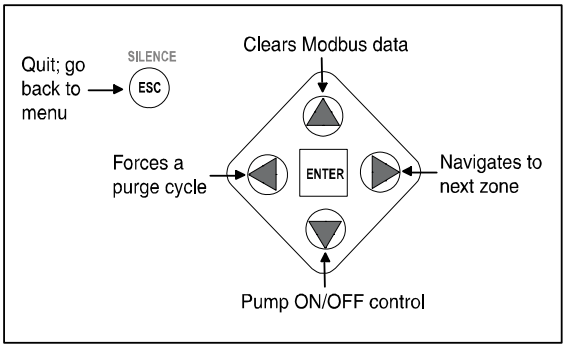
Navigating to the Diagnostic Screen

On the **System Setup** screen, select the Diagnostic option (**DIAG)**.

Diagnostic Screen



Diagnostic Options & Controls



Diagnostic Screen Overview

The **Diagnostic Screen** contains sensor data and status information useful for trouble shooting various fault conditions. An explanation of the information provided on each line of this screen is listed below, including normal operating ranges.

DET: Detector Voltage – Peak-to-peak output of the IR sensor. In the absence of gas, this value range is 3.900V to 4.500V.

AVE: Average Detector Voltage – Running average of the values displayed in line 1.

ZERO: Zero Voltage – IR sensor output that was stored during the last purge cycle and has the same range as line 1.

NOISE: A 16 point running average of the noise portion of IR bench output. This reading is valuable mostly when refrigerant is **not** present.

AVEAU: Average Absorbency – Optical absorbency computed from the Average Detector Voltage and Zero Voltage. In the absence of refrigerant, the absorbency is 0.000AU. When sampling refrigerants, its value varies proportionally with the refrigerant concentration.

UM/L: uMoles/L – Absolute concentration in micro-moles per liter of refrigerant based on Noise and the internal calibration. There are two figures displayed. The first (annotated by a B) is the actual measurement at the IR bench. The second is the calculated value corrected to ambient conditions (temperature + pressure).

PPM: Parts Per Million is the volume concentration referenced to standard temperature and pressure and is computed from the Average Absorbency, Zero Temperature and Ambient Pressure. There are two figures displayed. The first (annotated by a B) is the actual PPM at the IR bench. The second is a PPM reading normalized to standard temperature and pressure.

ZERO: Zero Temperature - Displays the sensor and enclosure temperature measured and stored during the last purge cycle in degrees C.

BENCH: Bench Temperature – Current IR sensor temperature in degrees C as well as the raw voltage coming from the temperature sensor. This value can range from ambient to ambient +15 degrees C.

BOX: Box Temperature – This is the current internal enclosure temperature along with the raw voltage from the temperature sensor, and has the same range as the Bench temperature.

PRESS: Pressure – This is the current absolute manifold pressure in PSIA along with the output voltage of the pressure sensor. This value should always be 0.2 to 1.0 PSIA below ambient (**AMB**).

VAC: Vacuum – The vacuum pressure is measured every purge cycle by closing all sample valves. Its value is typically 2.5 to 4.0 PSIA below ambient pressure.

AMB: Ambient – Ambient pressure is measured every purge cycle with the sample pump off and the manifold open. Its value is weather and altitude dependent and can range from 10.0 to 15.5 PSIA.

FAULT CODE: See Fault Code list.

(XXXX FEET): Programmed length of tubing for an active zone.

MODBUS data:

485 RX=x	Receive port number of bytes
485 TX=x	Transmit port number of bytes
FUNC	Function
REG=xxxxx	Register address

Service Mode

The Service Mode option is located on the **System Setup** screen in the bottom right corner.

When activated, the Service Mode will disable the HGM-MZ unit for a specified length of time. The default is 60 minutes. This time interval can be changed as described in the *Service Timeout* section on page 29.

IMPORTANT: Note that while in the Service Mode no measurements are made, nor are any alarms activated.

Access the service mode options from the initial **Data Display Screen.** Press the **SERVICE MODE ENTRY** option **twice within 3 seconds**.

To exit the Service Mode, again press the **SERVICE MODE ENTRY** option **twice within 3 seconds**.

5 Maintenance

⚠ Warnings & Cautions

WARNING: *Shock hazard! Always disconnect AC power before opening the enclosure of the monitor.*

CAUTION: *The HGM-MZ contains sensitive electronic components that can be easily damaged. Do not touch nor disturb any components. Do not dislodge electrical wiring or pneumatic tubing.*

Charcoal Filter

The charcoal filter removes refrigerant gas from the purge-air stream during the purging process. Replace the charcoal filter (P/N 3015-3125) approximately every 6 months, when a zero filter fault occurs (fault code <0100>), or after the monitor has been exposed to unusually high levels of refrigerant gas, such as after an evacuation alarm.

Hydrophobic Filter

The hydrophobic filter prevents water from entering the IR detector. A zone flow fault will occur (fault code <0800>) if this filter becomes blocked. Replace the hydrophobic filter as required (P/N 07-1650).

Servicing Air Lines & Replacing Termination Filters

The gas sample line and optional exhaust line should be periodically checked for obvious signs of kinks, damage and contamination. Replace the tubing as required (P/N 304-3235).

The gas-sample line and purge-line termination filters prevent dust and dirt from entering the monitor. Both of the filters should be periodically checked and replaced when there are obvious signs of contamination.

- A zone flow fault will occur (fault code <0800>) if the gas-sample line filter becomes blocked
- A purge flow auto will occur (fault code <1000>) if the purge-line filter becomes blocked.

Remove the filter from the line and replace it with a new one (P/N 3015-3420).

Fuses

The HGM-MZ is protected from electrical damage by two, 1A, 250 V, type “F” fuses. Locate the fuse holders (page 14) and carefully remove the fuses from their holders. Inspect and test the fuses with an ohm meter for continuity. Replace the fuses as required (P/N 04-2620). Battery shelf life is 10 years.

Clock Battery

The clock battery maintains the correct date and time when AC power is not applied to the monitor. Replace this battery approximately every 2 years (P/N 204-0020).

Sample Pump

The sample pump draws the gas sample into the monitor through the IR detector and discharges the sample via the exhaust port. To replace the pump, remove the inlet and outlet tubing, disconnect the AC power wires from the pump and remove the pump from the monitor. Install a new sample pump (P/N 3015-5176).

Intake Manifolds

Up to three additional intake manifolds (P/N 3015-5171 & 3015-3411) can be installed in the HGM-MZ to increase the total capacity to 16 zones. Each manifold requires a sample line end filter for each of the 4 zones.

Please follow the instructions provided to install the manifolds. Then follow the instructions earlier in this manual to install the air lines and complete the zone programming steps. The HGM-MZ setup must also be updated to recognize the new zones.

4–20 mAdc Interface Board

The optional 4–20 mAdc Interface Board (P/N 3015-5152) allows the operator to take advantage of the current loop interfaces provided for connection of external devices to the HGM-MZ. The interface board plugs into the sockets provided on the valve/pump drive PCB, and the external devices are then cabled to the HGM-MZ as described earlier in this manual.

Replacement Parts & Optional Accessories

Replacement Parts	
Item Description	**Part Number**
HGM-MZ complete assembly (4 Zone) (8 Zone) (12 Zone) (16 Zone)	3015-5043 3015-5044 3015-5045 3015-5046
Battery: Panasonic CR2032, 3V	204-0020*
Filters:	
Charcoal, Zero Air Hydrophobic Termination (gas sample line)	3015-3125 07-1650 3015-3420
Fuse: 1.0 A, 250 V, Type “F”	04-2620
Replacement Pump	3015-5176
Tubing: ¼ in OD (250 ft.)	3015-3235
***Warning**: In compliance with agency approvals & safety regulations, the battery must be replaced with the specified Bacharach replacement part.	
Optional Accessories	
Item Description	**Part Number**
Surge Protectors:	
120 V 4-20 mA	3015-4121 3015-4123
Alarms:	
Audible/Visual 120 VAC	3015-3076
Interface Board, 4-20 mA	3015-5152
Annual Maintenance Kit	3015-5199
Four Port Expansion Kit	3015-5171
Four Zone Line End Filters Kit	3015-3411

Specifications

HGM-MZ Specifications	
Product Type	Multiple refrigerant gases and multiple area monitoring system for low level continuous monitoring of CFC, HCFC and HFC refrigerant gasses used in most commercial refrigeration systems. System design supports compliance to the refrigerant monitoring requirements of ANS/BSR ASHRE 15-1994.
Coverage	4 point standard, expandable to 16 points in 4 point increments
Detector Type	Infrared Non-Dispersive
Gas Library:	
CFC:	R-11, R-12, R-113, R-114, R-502, HFP
HFC:	R-404a (HP62), R-407a, R-407c (AC9000), R-134a, R-410a (AZ20), R-507 (AZ50), R-508b (SUVA95), R236FA, R125, R245Fa, R422a, R422d, R427a
HCFC:	R-22, R-123, R-124, R-500, R-503, R-401a (MP39), R-402a (HP80), R-402b (HP81), R-408a, R-409a, R-23, R21, R227
HALON:	H1301,H2402, H1211
Other:	FA188, FC72, N1230
Sensitivity	All gasses 1 ppm (R11 ±10 ppm ±15% of reading 0-1000ppm)
Measuring Range	All gasses 0 to 10,000 ppm
Accuracy	±1ppm ±10% of reading from 0-1000ppm (R11 ±10ppm ±15% of reading 0-1000ppm)
Front Panel	3 Indicator lights: • Green = Monitor is powered on. LED glows during normal operation; flashes when unit is in warm-up mode • Red = Alarm. LED flashes when any point has exceeded the alarm setting. • Yellow = Fault. LED flashes when there is a system fault
Size/Weight	12.23" H x 13.7" W x 4.96" D / 15 lbs.
Temperature Drift	±0.3% of reading per degrees C
Sampling Mode	Automatic or manual (hold)
Re-Zero	Auto or on zone change
Response Time	5 to 120 seconds – depending on air line length and number of zones
System Noise	Less than 40dB(A) @ 10 feet (3m)
Monitoring Distance	1,200 ft. maximum for combined length of sample + exhaust tubing (each zone)
Conditioned Signal	Dual optional 4-20mAdc isolated outputs. Channel 1 = zone area, Channel 2 = PPM
Alarms	Four SPDT alarm contacts are provided (rated 2A 250VAC) Three assigned to PPM level alarms, one assigned to system faults
Communications	Full two-way communication with HGM-RD Display Module or Building Management System via RS-485 serial interface. RS-232C communication port standard
Power Safety Mode	Fully automatic system reset. All programmed parameters retained.
Operating Temp	32 to 122 °F (0 to 50 °C)
Ambient Humidity	5% to 90% RH (non-condensing)
AC Power	100 to 240 VAC, 50/60 Hz, 20 W
Certification	UL 61010-1, CAN/CSA 22.2 No. 61010-1 & CE Mark
Warranty	2 years from date of shipment
Altitude Limit	6,562 ft (2,000 m)
Specifications subject to change without notice	

Appendix A - Recommended Alarm Settings & Gas Enumeration

Refrigerant	Leak PPM	Spill PPM	Evacuate PPM	Decimal	Hex
R11	100	300	500	0	00
R12	100	300	500	1	01
R22	100	300	500	2	02
R23	100	300	500	3	03
R113	100	300	500	4	04
R114	100	300	500	5	05
R123	25	35	50	6	06
R124	100	300	500	7	07
R134A	100	300	500	8	08
R401A	100	300	500	9	09
R402A	100	300	500	10	0A
R402B	100	300	500	11	0B
R404A	100	300	500	12	0C
R407A	100	300	500	13	0D
R407C	100	300	500	14	0E
R409A	100	300	500	15	0F
R410A	100	300	500	16	10
R500	100	300	500	17	11
R502	100	300	500	18	12
R503	100	300	500	19	13
R507	100	300	500	20	14
R508B	100	300	500	21	15
H1301	100	300	500	22	16
R408A	100	300	500	23	17
FA188	100	300	500	24	18
R236FA	100	300	500	25	19
N1230	100	300	500	26	1A
R227	100	300	500	27	1B
HFP	100	300	500	28	1C
FC72	100	300	500	29	1D
R21	100	300	500	30	1E
R125	100	300	500	31	1F
H1211	100	300	500	32	20
H2402	100	300	500	33	21
R245FA	100	300	500	34	22
R422A	100	300	500	35	23
R422D	100	300	500	36	24
R427A	100	300	500	37	25

Allowable Exposure Level (AEL) ASHRAE 34-1992.

Appendix B

RS-485 Communication Protocol

Overview

The following instructions are intended as a guide for integrating the HGM-MZ network into a Building Management System. If you are unfamiliar with complex systems of this type, it is recommended that you contact Bacharach for technical assistance.

MODBUS RTU Protocol

The HGM-MZ monitor communicates with master devices (such as the HGM-RD or a Building Management System) over the RS-485 serial interface. Because the monitor is configured with a two wire RS-485 serial bus, data transmission occurs in 'half-duplex" mode. Therefore, only one device may be in transmit mode at any given time.

Programmers should refer to the "MODBUS Protocol Reference Guide" for details and more comprehensive instructions. The guide is available on the Modicon web site at:
http://www.modicon.com/techpubs/TechPubNew/PI_MBUS_300.pdf

Specific communication software is available at: http://www.bacharach-inc.com/downloads.htm

HGM-MZ MODBUS RTU Operation

Overview

The HGM-MZ and HGM-RD are equipped to communicate with other equipment using the MODBUS RTU protocol. Using this communication channel a MODBUS master device may communicate with up to 15 HGM-MZs on a communications network, exchanging measurement information, alarm data, fault data, history (logs and trends) and setup information. Additionally, the MODBUS master can control the operating state of an HGM-MZ, placing the HGM-MZ in any of its different operating modes. The network may be configured so that the HGM-MZs are connected directly to the MODBUS master device, or the MODBUS master device may communicate with the HGM-MZs through the HGM-RD.

(**NOTE:** This document was written with the assumption that the reader is familiar with the various setup parameters and operational modes for the HGM-MZ.

Protocol Details

A 2 wire RS-485 bus is used for transmission, therefore communication occurs in a Half-Duplex mode. The HGM-MZ is a slave device and will respond to queries in the MODBUS RTU format from a master device.

Two MODBUS functions are supported. They are function 03 (read holding register) and function 16 (Preset Multiple registers). Please refer to the MODBUS Protocol Reference Guide (available at www.modicon.com/techpubs/techPubNew/PI_MBUS_300.pdf) for protocol detail and use instructions.

Using the two MODBUS functions, a master device may read, modify and write data and status information to any HGM on the network. HGM data is organized into structures (internal to the HGM-MZ) which can be accessed by the MODBUS registers defined in this document. A corresponding set of data structures should be maintained by the master device. These master device data structures become the destination for responses to read queries and sources for preset register commands. When a read holding register query is made by the master device the HGM-MZ responds by sending the contents of the structure referenced by the specified register. After the master validates the HGM-MZ response using the CRC bytes, it must then move the data into its matching data structure before individual items may be accessed or modified. Therefore, the master data structure should correspond to the HGM-MZ data structure byte for byte. Note that some data structures have been divided into multiple registers due to MODBUS RTU message length constrains. To change a setting in the HGM-MZ, the master device first reads the register structure that contains the data item to be modified, makes the desired change, then sends the structure back using the preset multiple register function. If the transaction is successful, the HGM-MZ sends the appropriate MODBUS response. It is the responsibility of the master device, when making modifications, to insure that all parameters transferred are within the working limits of the HGM-MZ.

HGM-MZ Polling

After the HGM-MZs are setup and operating, the master device need only poll each HGM for its status register which contains summary data of the HGMs alarms, faults, and operating state. If exceptions are detected through the status register and more details are required, additional registers can be examined. Also if current PPM values are required, the PPM register provides access to current PPM values for all zones. The HGM-MZ requires a minimum of 20 seconds to complete a gas concentration measurement for a single zone. Therefore, it is not necessary to poll the HGM-MZ more frequently than once every 15-20 seconds, as there will not be any new data available/obtained by more frequent polling. In fact, excessive polling will slow the operation of the HGM-MZ. Under no circumstances should the HGM-MZ be continuously polled at rate faster than 500mS, as this could result in erroneous readings by the HGM-MZ.

Network Topologies

HGM-MZs may be connected directly to the MODBUS network or they may be connected to the network through an HGM-RD. In either case, each HGM-MZ must have a unique node ID. Up to 15 HGM-MZs can be connected directly to the MODBUS network.

If HGM-MZs are accessed via an HGM-RD connected to a MODBUS network, the HGM-RD “BMS enabled” parameter must be set equal to “1” via the “RDM SETUP” screen on the HGM-RD. The same commands and registers are used to communicate with the HGM-MZ directly or through the HGM-RD. If the communications is through the HGM-RD, it monitors each MODBUS message to determine if the message is intended for one of the HGM-MZs it is connected to. If it is, the HGM-RD passes the message through to the

HGM-MZs. If it is not, the message is not passed through. The HGM-RD does not make any modifications to MODBUS messages. It simply passes the query through to the HGM-MZ, and passes the response back to the MODBUS master. In other words, it allows the HGM-MZs to be logically connected to the MODBUS network, when physically they are connected to the local HGM-RD network. It is very important to understand that the HGM-RD will only pass messages through to the HGM-MZ when the HGM-RD is either in the "SYSTEM" screen or the "ZONE VIEW" screen. If the HGM-RD is in any other screen, it will return a MODBUS "busy" exception response (exception code 06).

All HGM-RD screens, except the SYSTEM and ZONE VIEW screens, have a 10 minute timeout interval. After This, the screen will return to the SYSTEM or ZONE VIEW screen, depending on which one was last displayed. The HGM-RD may also be password protected so that a password entry is required in order to view screens other than the SYSTEM or ZONE VIEW screen.

Key Comm Protocol Parameters

MODBUS Mode: RTU only

HGM-MZ Baud Rate: Default is 19,200. Programmable as defined in System data register

Parity: No Parity

Stop Bits: Default is 1. Can be set for 2 via System data register

Maximum Response Time:

4000mS when directly accessing the HGM-MZ

8,000mS when accessing the HGM-MZ through the HGM-RD.

Error Checking: CRC per MODBUS specifications

NOTE: All data sent out from the HGM-MZ is in "little endian" byte order (Least significant byte followed by most significant byte). This should be taken into account if the master that process the data is a "big endian" type. Non-data information (starting address, number of points, etc.) follows normal MODBUS protocol, which is Big Endian.

Summary of Registers

Register Name Number	HEX	Decimal	Description	
System Data	0x0010	16	R/W	HGM System Setup Data
Status	0x0011	17	R/W	Operating summary of faults, alarms and status
Zone Data	0x12xx	4609 - 4630	R/W	Setup data for up to 16 zones (xx defines zone number)
CAL Data	0x0014	20	R/W	Cal Factors for all gases
Date/Time	0x0015	21	R/W	Set HGM-MZ date & time
Sensor Data	0x0016	22	R	Raw measurement of sensors
Rel. Hold	0x0017	23	W	Release HGM-MZ out of hold mode
Hold Zone	0x0018	24	W	Put HGM-MZ into hold mode
Fault Log	0x19xx	6400 6401	R	20 most recent fault events (xx = 00 or 01)
Flow Log	0x001F	31	R	20 most recent flow fault events
Alarm Log	0x1Axx	6656 6657 6658	R	20 most recent alarm events (xx = 00, 01, or 02)
Serv. Mode	0x001B	27	W	Puts HGM-MZ into service mode
Rel Serv.	0x001C	28	W	Release HGM-MZ from service mode
PPM	0x001E	30	R	PPM values for all zones
Zone Log	0x3yxx	0-6	Trend data for each HGM-MZ zone [y = zone number (starting at 0), xx = 00 – 06] Data	

Data Type Abbreviations	
C	Character
Float	Floating Point
I	Integer
TIM	Time
UI	Unsigned Integer

System Data Register Register 0x0010hex 16dec R/W 54 bytes

Variable	Type	Length	Description
Type	UI	2 bytes	Indicates EEPPROM has been initialized if value = 300 **DO NOT MODIFY**
REV	Float	4 bytes	Firmware Rev Level **DO NOT MODIFY**
SN	UI	2 bytes	Firmware Serial Number **DO NOT MODIFY**
Node	UC	1 byte	Network Slave Node # (valid values are 1-15). The default is that indicated by the Node DIP Switch on main board.
Location	C	13 bytes	Array defining text name of unit
Stop_Bits	C	1 byte	Number of stop bits used in the HGM-MZ data stream. Default = 1. Other available value is 2
Aud_Alarm	UC	1 byte	Sounds internal board buzzer on condition; 0 = no buzzer; 1= Alarm; 2=Fault; 3=Leak; 4=Spill; 5=Evacuate; 6=Monitor Off line (DEFAULT = 0)
Alarm_Ack_ Mode	UC	1 byte	Defines Alarm Operation. Manual Acknowledge = 0; Auto Acknowledge = 1 (DEFAULT = 0)
Num_Zones	UC	1 byte	Number of install zones (Value initialized during auto detect during Power On Self Test).
UNUSED	TIM	13 bytes	UNUSED
Rezero_Mode	UC	1 byte	Defines rezero mode. Auto Rezero = 0; Rezero every zone = 1 (DEFAULT = 0)
Hold_Time	UI	2 byte	Length of zone hold interval in minutes (DEFAULT = 15 minutes)
Det_Limit	UC	1 byte	Minimum detection limit (in PPM). Concentrations less than or equal this value will read as 0 PPM (DEFUALT = 0 PPM)
Avg_Size	UC	1 byte	Size of running average used in computing PPM value. **DO NOT MODIFY**.
Loop2_factor	Float	4 bytes	Defines PPM current loop output. (DEFAULT = 0.16mA/PPM)
Serv_Mode_TO	UI	2 bytes	Service Mode Timeout value (in minutes). (DEFAULT = 60 MINUTES)
RS485_BAUD	UI	2 bytes	BAUD RATE for RS-485 connection (between HGM-RD and HGM-MZ or MODBUS master and HGM-MZ depending on the Network topology). Default=9 (19.2K); other values are 8=9600, 7=4800
UNUSED	UI	2 bytes	UNUSED

Status Register Register 0x0011hex 17dec R/W 10 bytes

Variable	Type	Length	Description
Mode	UC	1 byte	Defines Operating Mode of HGM-MZ. 0 = normal Mode; 1 = Zone_Hold Mode; 2 = Diagnostic Mode; 3 = Service mode. **DO NOT MODIFY (use zone hold register or service mode register to change this parameter)**
State	UC	1 byte	Defines HGM-MZ Current State. 0 = Idle; 1 = Sampling; 2 = Zeroing; 3 = Warm Up, 4 = Pressure Check **DO NOT MODIFY**
Measuring	UC	1 byte	Value = 1 if unit is acquiring detector signal for running avg. **DO NOT MODIFY**
Active_Zone	UC	1 byte	Current Zone being checked. 0=zone1, 1=zone2, etc.
Max _Alarm	UC	1 byte	Indicates highest non-acknowledged alarm level **DO NOT MODIFY**
Alarm_Count	UC	1 byte	Number of alarms that are currently active. **DO NOT MODIFY**
UNUSED	UC	1 byte	UNUSED
Loop_Card	UC	1 byte	Value = 1 if 4-20mA card has been detected. **DO NOT MODIFY**
Fault	UI	2 bytes	See Note Below

Fault Flag Structure uses bitwise access to 16 bit word as defined below:

Fault Code Table

BIT	Fault Type	Code	Description
15	CLIPPING FAULT	0x8000	0x8000 Sensor output voltage too high
14	ZERO RANGE FAULT	0x4000	Sensor output voltage outside limits during purge
13	OVER RANGE FAULT	0x2000	Gas concentration above measurable range
12	PURGE FLOW FAULT	0x1000	No flow detected during purge cycle
11	ZONE FLOW FAULT	0x0800	No flow detected during sample cycle
10	A2D FAULT	0x0400	Analog to digital converter not working
9	GAIN SET FAULT	0x0200	Digipot gain setting out of normal range
8	ZERO FILTER FAULT	0x0100	Charcoal filter (if used) needs replacement
7	CONFIG FAULT	0x0080	No zones are enabled
6	UNUSED FAULT 2	0x0040	
5	UNUSED FAULT1	0x0020	
4	LOOP FAULT	0x0010	Current loop is open
3	RS485 FAULT	0x0008	Communication error
2	MANIFOLD P FAULT	0x0004	Pressure sensor readings are out of range
1	BENCH T FAULT	0x0002	Sensor temperature is out of range
0	BOX T FAULT	0x0001	Chassis temperature is out of range

Zone Data Register 0x12xxh R/W 78 bytes

Each zone for an HGM-MZ has a separate Zone data structure that is 78 bytes long. The zone number is the low order byte in the register address (i.e., Zone 1 data register = 0x1201h)

Variable	Type	Length	Description
Location	C	13 bytes	13 byte array, Alpha Numeric Description or Name of Zone
Flow OK	UC	1 byte	Status of Flow check. Value of 1 indicates flow check is good. **DO NOT MODIFY**
Refrigerant Type	UC	1 byte	See note 1 Below (DEFAULT = R134a)
Distance	UI	2 bytes	Zone Tubing Length (in feet) (DEFAULT = 100 feet)
Zone Temp	I	2 bytes	Avg temp at zone (degrees C) (DEFAULT = 25°C)
Concentration	Float	4 bytes	Last Measured concentrations (uM/L) **DO NOT MODIFY**
Concentration2	Float	4 bytes	Last Measured concentration (PPM) **DO NOT MODIFY**
Alarm Ack	UC	1 bytes	Set value to 1 to acknowledge Alarm. **NOTE:** HGM-MZ will reset this byte to 0 when the Alarm byte (below) is = 0 and zone in alarm is sampled. If the alarm condition/byte increases (leak>>spill or spill>>evac) the HGM-MZ will also reset this byte to 0
Alarm	UC	1 bytes	Alarm Status; 0 = no alarm, 1 = leak; 2 = spill; 3 = evac.
Leak Level	UI	2 bytes	Level to trigger a leak alarm (in PPM) (DEFAULT = 100)
Spill Level	UI	2 bytes	Level to trigger a spill alarm (in PPM) (DEFAULT = 300)
Evac Level	UI	2 bytes	Level to trigger a evacuate alarm (in PPM) (DEFAULT = 500)
Peak PPM	UI	2 bytes	Highest Recorded PPM in zone
Peak Time	TIM	13 bytes	Date an time of highest peak (see note 2 for format)
Alarm Time	TIM	13 bytes	Date and time of last alarm (see note 2 for format)
Not Used		13 bytes	
Log Interval	UI	2 bytes	Number of minutes between Log entries (DEFAULT = 1440)

NOTE 1: Refer to the **Recommended Alarm Settings & Gas Enumeration** table on page 47.

NOTE 2: Time Structure Format consists of 13 unsigned character types. They are 1 second digit, 10 second digit, 1 minute digit, 10 minute digit, 1 hour digit, 10 hour digit, 1 day digit, 10 day digit, 1 month digit, 10 month digit, 1 year digit, 10 year digit, last byte is unused.

Alarms & Alarm Acknowledge

The HGM-MZ can be operated in two different alarm acknowledge modes, Auto and Manual (set via the alarm_ack_mode variable in the system data register). For purposes of this discussion, the term “Alarm” refers to a HGM-MZ state where the alarm light is on and the appropriate alarm relay is activated. The term “Alarm condition” refers to the external condition (i.e., refrigerant leak) that initially causes the HGM-MZ to go into an alarm. If an alarm occurs it can be handled in one of 3 ways.

1. **Non-Latching Mode**. This mode is enabled by setting the AUTO_ACK_MODE parameter in the system register to “1”. In this mode, if an alarm condition occurs an HGM-MZ alarm will be created. If the alarm condition is subsequently removed, the HGM-MZ alarm will automatically be cleared by the HGM-MZ when the zone in alarm is sampled “clear”. Note, in this mode of operation, it is possible for an alarm to occur and be cleared without user or MODBUS master intervention. If this is the case, the only evidence of the alarm would be contained in the HGM-MZ alarm log.
2. **Latching Mode with Silence**. This mode is enabled by setting the AUTO_ACK_MODE in the system register to “0”. In this mode, if an alarm condition occurs, an HGM-MZ alarm will be created. In order for the alarm to be removed the MODBUS master will write a “0” to the ALARM parameter in the ZONE register. This will cause the alarm to be “silenced” in the HGM-MZ (i.e., the alarm relays will return to their normal state and the ALARM lamp will be extinguished). The next time the zone with the alarm condition is sampled, if the alarm condition still exists, the alarm will be reactivated and the alarm parameter will be reset to “1” in the HGM-MZ. Otherwise, if the alarm condition has cleared, no further action is required and normal operation will resume.
3. **Latching Mode without Silence**. This mode is enabled by setting the AUTO_ACK_MODE in the system register to “0”. In this mode, if an alarm condition occurs, an HGM-MZ alarm will be created. The HGM-MZ MODBUS master will then write a “1” to the ALARM ACK parameter in the zone register. The alarm will continue to persists (i.e., Relays in alarm state and Alarm light on) until the offending zone is sampled and no alarm condition is detected. At that point, the ALARM ACK parameter is automatically cleared by the HGM-MZ, as is the ALARM parameter. **NOTE:** If the ALARM ACK parameter is set to “1” and the ALARM CONDITION is upgraded (from leak to spill, or spill to evacuate) the ALARM ACK parameter will automatically be cleared to “0” by the HGM-MZ.

Date Time Register Register 0x0015h 21dec R/W 14 bytes

Variable	Type	Length	Description
Date_Time	Time	14 bytes	Contains current time and date. Structure is defined as in note 2 of zone data

Time Structure Format consists of 14 unsigned character types. They are 1 second digit, 10 second digit, 1 minute digit, 10 minute digit, 1 hour digit, 10 hour digit, a day digit, 10 day digit, 1 month digit, 10 month digit, 1 year digit, 10 year digit, day of the week, last byte is unused.

Sensor Data Register Register 0x0016h 22dec R 82 bytes

Variable	Type	Length	Description
Pressure	Float	4	Manifold Pressure is PSIA
P_Volts	Float	4	Pressure sensor output Voltage
Vacuum_P	Float	4	Pressure with all value closed and pump on in PSIA
Ambient_P	Float	4	Absolute Ambient Pressure in PSIA
Box_T	Float	4	Enclosure Temperature in Degrees C
Box_T_Volts	Float	4	Box temp sensor output voltage
Bench_T	Float	4	Optical bench temperature in Degrees C
Bench_T_Volts	Float	4	Bench temp sensor output voltage
Bench_Z_T	Float	4	Optical bench temp in degrees C at last zero interval
Box_Z_T	Float	4	Box temp in degrees C at last zeroing
PkPk_int	UI	2	Current peak to peak A/D counts from detector
PkPk	Float	4	Current peak to peak voltage from detector
Ave_PkPk	Float	4	Running average voltage from detector
Zero_PkPk	Float	4	Voltage measured at last zeroing
Noise	Float	4	Largest Change in running average
AU	Float	4	Current absorbance value
Ave_AU	Float	4	Running Average of absorbance level
Bench_PPM	Float	4	PPM in bench based on zone gas selection (uncorrected for pressure and temperature)
STP_PPM	Float	4	PPM corrected to STP (1 atm, 25 deg C)
Bench_UML	Float	4	Micromoles/liter in bench (uncorrected0
Ambient_UML	Float	4	Micromoles/liter corrected to ambient pressure

Release Zone Hold Register Register 0x0017h 23dec W 10 bytes

Variable	Type	Length	Description
Rel_Hold	*	*	See description of STATUS REGISTER

Hold Zone Register Register 0x0018h 24dec W 10 bytes

Variable	Type	Length	Description
Zone_Hold	*	*	See description of STATUS REGISTER

HGM-MZ Hold Mode

The HGM-MZ can be made to hold or “dwell” on a particular zone if necessary. The length of the hold time is defined by the HOLD TIME parameter in the System Data Register.

Placing the HGM-MZ into hold mode:

1. Read the HGM-MZ Status Register (0x0011h)
2. Modify the content of the status register structure to change the MODE parameter to zone hold mode. Active zone parameter to the zone you wish to hold
3. Send this updated status register structure back to the HGM-MZ using PRESET MULTIPLE REGISTER COMMAND to the HOLD ZONE REGISTER (0x0018h).

Releasing the Zone hold:

1. Read the HGM-MZ Status Register (0x0011h)
2. Modify the content of the status register to change the MODE parameter to normal mode. Active zone parameter to the zone which you would like to resume normal activity on
3. Send this updated status register structure back to the HGM-MZ using PRESET MULTIPLE REGISTER COMMAND to the RELEASE HOLD REGISTER (0x0017h).

Fault Log Register Register 0x1900, 0x1901h 6400, 6401dec R 302 bytes

These registers contain the 20 most recent fault events, the time they occurred, and a pointer to the most recent event. The data is split into 2 registers. The first register contains 200 bytes and the second register contains 102 bytes. The results of these two register reads should be recombined into the Fault Log Data Structure after both have been received

Variable	Type	Length	Description
Fault	UI	40 bytes	20 most recent fault events. Each event is decoded as indicated in Fault Flag Structure given after the Status Register Description
Time	TIM	260 bytes	Time of each fault occurrence. TIM value as defined in NOTE 2 of Zone Data
Ptr	UC	1 byte	Pointer to most recent event
Unused	UC	1 byte	

Flow Log Register Register 0x001F 31dec R 142 bytes

Variable	Type	Length	Description
Flow Event	UI	40 bytes	20 most recent flow fault events. Each bit of the unsigned int represents a zone and a 1 indicates no flow. Zero indicates flow.
Purge Flow Event	UC	20 bytes	20 most recent flow fault events where a 1 indicates no flow. Zero indicates flow.
Time	UC	80 bytes	Time/date stamps for 20 most recent logged flow events. This variable is an unsigned long integer formatted as seconds since Jan 1 of 1980
Ptr	UC	1 byte	Pointer to most recent event
Unused	UC	1 byte	Unused

Alarm Log Register Register 0x1A00h, 0x1A01h, 0x1A02h (6656, 6657, 6657dec) R 582 bytes

These registers contain the 20 most recent alarm events, the time they occurred, and a pointer to the most recent event. The data is split into 3 registers and should be recombined into an appropriate structure after all three registers have been received. Register 0x1A00h contain 200 bytes, Register 0x1A01h contains 200 bytes, and register 0x1A02h contains 181 bytes.

Variable	Type	Length	Description
Event	UC	320 bytes	20 most recent alarm events. Each event contains 1 byte for each zone. Each zone Byte is defined as 0=No Alarm, 1=Leak Alarm, 2=Spill Alarm, 3=Evac Alarm.
Time	TIM	260 bytes	Time of each alarm event. TIM value as defined in NOTE 2 of Zone Data
Ptr	UC	1 byte	Pointer to most recent event
Unused	UC	1 byte	

Service Mode Register Register 0x001B/hex 27dec W 10 bytes

Variable	Type	Length	Description
Rel_Svc_Mode	*	*	See description of STATUS REGISTER

Release Service Mode Register Register 0x001Chex 28dec W 10 bytes

Variable	Type	Length	Description
Ent Svc_Mode	*	*	See description of STATUS REGISTER

HGM-MZ Service Mode

The HGM-MZ can be placed into service mode if necessary. During service mode the unit will take no measurements, any and all alarms are silenced, and all relays are opened. The unit automatically comes out of service mode after a preset interval defined by the service_mode_TO parameter in the System Data Register.

Placing the HGM-MZ into Service Mode:

1. Read the HGM-MZ Status Register (0x0011h)
2. Modify the content of the status register structure to change the MODE parameter to service mode.
3. Send this updated status register structure back to the HGM-MZ using PRESET MULTIPLE REGISTER COMMAND to the SERVICE MODE REGISTER (0x001Bh).

Releasing the unit from Service Mode:

1. Read the HGM-MZ Status Register (0x0011h)
2. Modify the content of the status register to change the MODE parameter to normal mode.
3. Send this updated status register structure back to the HGM-MZ using PRESET MULTIPLE REGISTER COMMAND to the RELEASE SERVICE MODE REGISTER (0x001Ch).

PPM Register Register 0x001Ehex 30dec R 32 bytes

Variable	Type	Length	Description
PPM	UI	32 bytes	16 Unsigned Integers that represent the PPM values for each HGM-MZ zone

NOTE: 16 values are returned independent of the number of actual zones installed in the unit. The master device is required to know how many zones are installed in the unit (available in the System Register) in order to properly interpret the data.

Zone Log Registers Register 0x3xyyh R 1502 bytes

These registers are used to transfer the zone log data. Each zone has a circular log of 100 past data points. The period between data points is defined by the Log Interval parameter in each corresponding Zone Data Register. The data for each zone is defined by the "x" place in the above register address. For zone 1 the Register address is 0x30yyh, for zone 2 the register address is 0x31yyh, etc. The data for each zone is sent in 8 consecutive registers due to MODBUS RTU message length constrains. The addresses are defined by the "yy" place in the above address. For zone 1, all log data can be obtained by reading 0x3000h, 0x3001h, 0x3002h, …… , 0x3007h. The first seven registers contain 200 bytes each and the last register contains 102 bytes. After all registers have been received the data should be reassembled into the full data structure.

Variable	Type	Length	Description
Index	UI	2	Point to current reading
Time	TIM	1300	Time record for each of the 100 log points. The format for the TIM type is defined in note 2 of zone data
PPM	UI	200	Last 100 log points (2 byes per point)

MODBUS Exception Responses

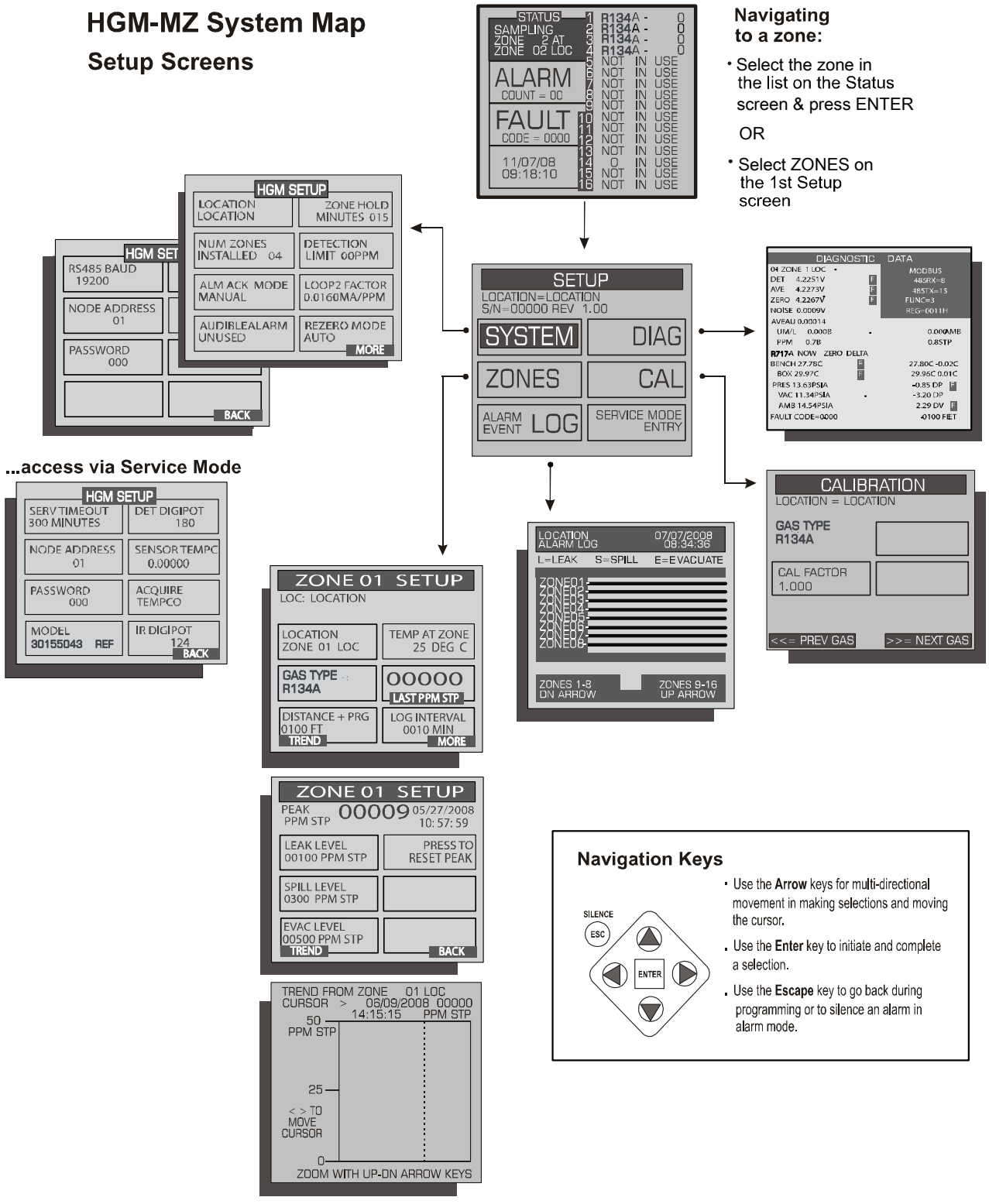
The following MODBUS exception responses are supported by the HGM-MZ:

01 Illegal Function

02 Illegal Data Address

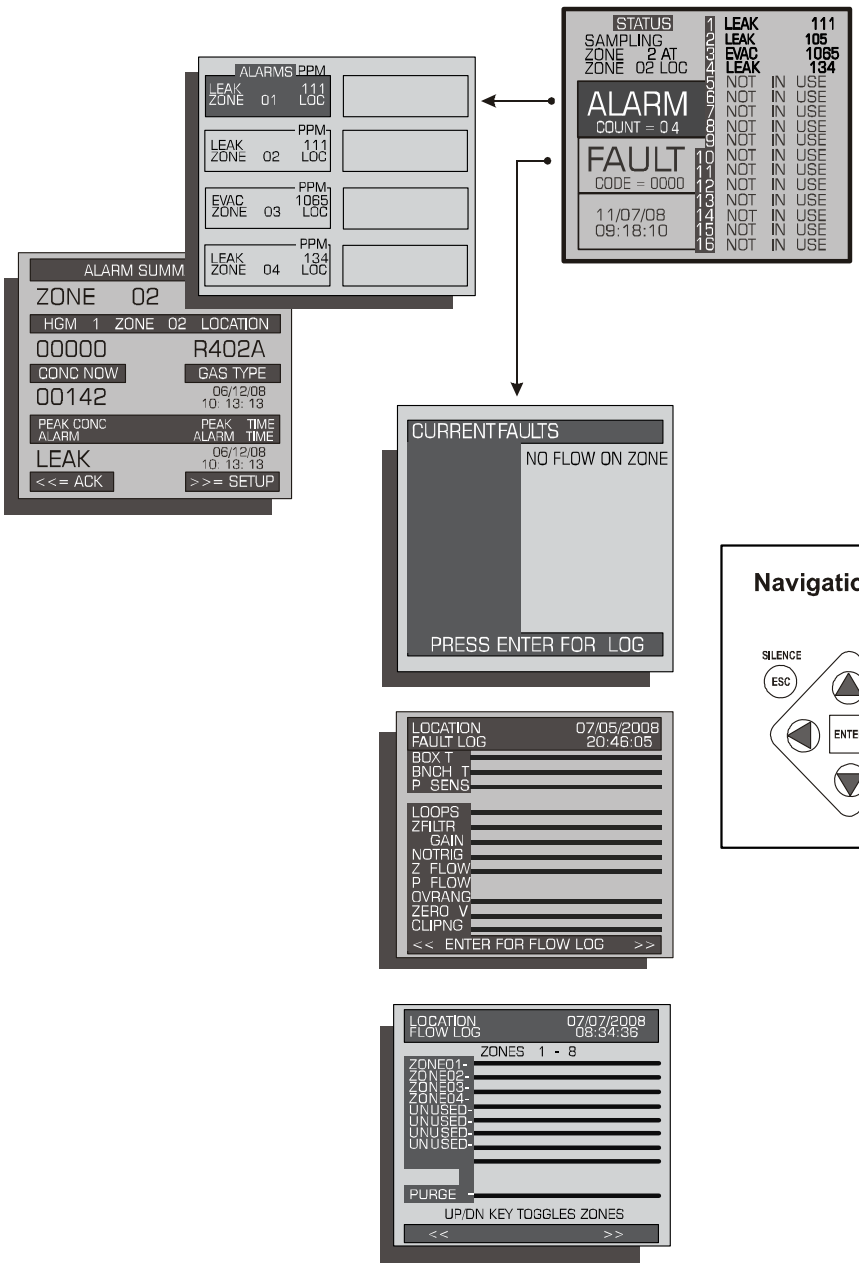
06 Slave Device Busy (Occurs only when HGM-MZ is connected to the bus through an HGM-RD and the HGM-RD is not in the SYSTEM or ZONE VIEW screen)

Appendix C


HGM-MZ System Map
Setup Screens
STATUS
SAMPLING
ZONE 2 AT
ZONE 02 LOC
ALARM
COUNT = 00
FAULT
CODE = 0000
11/07/08
09:18:10
R134A
NOT IN USE
Navigating to a zone:
• Select the zone in the list on the Status screen & press ENTER
OR
• Select ZONES on the 1st Setup screen
HGM SETUP
LOCATION
ZONE HOLD MINUTES 015
NUM ZONES INSTALLED 04
DETECTION LIMIT 00PPM
ALM ACK MODE MANUAL
LOOP2 FACTOR 0.0160MA/PPM
AUDIBLEALARM UNUSED
REZERO MODE AUTO
MORE
HGM SET
RS485 BAUD 19200
NODE ADDRESS 01
PASSWORD 000
BACK
SETUP
LOCATION=LOCATION
S/N=00000 REV 1.00
SYSTEM
DIAG
ZONES
CAL
ALARM EVENT LOG
SERVICE MODE ENTRY
DIAGNOSTIC DATA
MODBUS
485RX=B
485TX=15
FUNC=3
REG=0011H
...access via Service Mode
HGM SETUP
SERV TIMEOUT 300 MINUTES
DET DIGIPOT 180
NODE ADDRESS 01
SENSOR TEMPC 0.00000
PASSWORD 000
ACQUIRE TEMPCO
MODEL 30155043 REF
IR DIGIPOT 124
BACK
CALIBRATION
LOCATION = LOCATION
GAS TYPE R134A
CAL FACTOR 1.000
<<= PREV GAS
>>= NEXT GAS
ZONE 01 SETUP
LOC: LOCATION
LOCATION ZONE 01 LOC
TEMP AT ZONE 25 DEG C
GAS TYPE R134A
00000
LAST PPM STP
DISTANCE + PRG 0100 FT
LOG INTERVAL 0010 MIN
TREND
MORE
LOCATION ALARM LOG
07/07/2008 08:34:36
L=LEAK S=SPILL E=EVACUATE
ZONE01
ZONE02
ZONE03
ZONE04
ZONE05
ZONE06
ZONE07
ZONE08
ZONES 1-8 DN ARROW
ZONES 9-16 UP ARROW
ZONE 01 SETUP
PEAK PPM STP 00009
05/27/2008 10:57:59
LEAK LEVEL 00100 PPM STP
PRESS TO RESET PEAK
SPILL LEVEL 0300 PPM STP
EVAC LEVEL 00500 PPM STP
TREND
BACK
TREND FROM ZONE 01 LOC
CURSOR > 06/09/2008 14:15:15 00000 PPM STP
50 PPM STP
25
< > TO MOVE CURSOR
0
ZOOM WITH UP-DN ARROW KEYS
Navigation Keys
SILENCE
ESC
ENTER
• Use the Arrow keys for multi-directional movement in making selections and moving the cursor.
• Use the Enter key to initiate and complete a selection.
• Use the Escape key to go back during programming or to silence an alarm in alarm mode.

HGM-MZ System Map

Alarm & Fault Screens



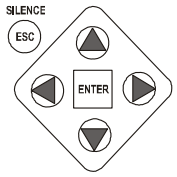
Navigating to a zone:

- Select the zone in the list on the Status screen & press ENTER

  OR

- Select ZONES on the 1st Setup screen

Navigation Keys



- Use the **Arrow** keys for multi-directional movement in making selections and moving the cursor.
- Use the **Enter** key to initiate and complete a selection.
- Use the **Escape** key to go back during programming or to silence an alarm in alarm mode.

NOTES:

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